STACK INFRASTRUCTURE

Black&White®

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L22

MIL05B

Underground Mechanical System – Technical Specifications

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1. INTRODUCTION

The present document, MIL05B-L22-SW-SW-SP-M-90001, constitutes an integral part of the executive project (RIBA3) of the mechanical systems, in compliance with the **DM 22 Gennaio 2008 n. 37**, it pertains to the production facility which is located to the south east of Milan part of Vignate (MI), designated for use as a Data Center.
This project was prepared by L22DC, a part of Lombardini22 S.p.A., headquartered at Via Lombardini 22, Milan, on behalf of the Client, INFRASTRUCTURE ITALIA LAND 2 S.r.l., with registered offices at Via del Bosco Rinnovato, 5, 20057 Assago (MI).

The present section, together with the remaining sections of the specifications, the attached drawings, and the documents provided by the Client regarding the general supply conditions, must be countersigned for acceptance on each page and returned to the Client. A thorough review of all documents is therefore a fundamental condition for proceeding with the quotation and execution of the systems. All the content herein is essential for correctly interpreting the guidelines and requirements outlined in the other project documents. In case of any doubts regarding the proper application of the content, the designer must be informed promptly to provide the necessary clarifications in a timely manner.
The designer cannot be held liable for any consequences arising from non-compliance with the above requirements.

The project of the underground services in the external areas has already been issued, the construction project produced by the General Contractor must verify its coordination.

For the definition of required activities related to Commissioning process, see the specific document drawn up by the Client.

1.1. Project introduction

The Project has been developed specifically for Stack EMEA.

The project is in Vignate, outside Milan, Italy.

The project name is known as MIL05B.

The project is a new build shell and technical fitout.

The Employer's design team members can be found in the main contract conditions and preliminarie.

MIL05B Consists of 12MW_{IT} (2 x 6 MW_{IT} data halls and admin block)

Although the building will not target Tier accreditation, engineering services shall adhere to "*concurrently maintainable and continuous cooling"* design principles and will allow continued operation under a single failure and permit maintenance to be undertaken without a reduction in service.

As such, the site design components will generally be designed with a minimum level of critical component resilience. Please refer to the technical report for the redundancy details.

The underlying aim of the design is to deliver as much flexibility and maximum utilisation of site space and resources available, whilst remaining within the limitations set out within the planning approval. As such, various allowances have been made to present a worst-case building size and profile. In some cases, the actual design shall be proved at a reduced proposal to that of the maximum.
The project comprises the development of a new data centre facility.
A resilient power and cooling infrastructure shall be provided to support the critical loads.

1.2. Project scope

The project and the fit-out of the facility will be carried out in phases.

The engineering contract shall include, but not be limited to, the following areas;

1. External:

a) Perimeter security;
b) Electronic security;
c) Carpark and external lighting;
d) Connections to sub ground drainage;
e) Incoming fibre and communications ducts;
f) Incoming mains water for domestic services;
g) Duct provision for secure vehicle access gate and gate house;
h) Security and communications ducts;
i) Fire suppression plant rooms;
j) Sitewide utilities and plant rooms

2. Ground Floor

a) Data Halls in their entirety;
b) Electrical room;
c) PV equipment room;
d) MV distribution and associated enclosures/rooms;
e) Loading bay;
f) Build and storage areas;
g) Goods lifts;
h) Passenger lifts;
i) Water tank rooms;
j) Facility Operation Centre (FOC);
k) Security Operation Centre (SOC);
l) Office and ancillary areas;
m) Client offices and board room;
n) Engineer stores and workshops;
o) Entrance Rooms (n.2) (POE);

p) Technical rooms
q) Storage rooms
r) Life safety systems;
s) Meet me rooms (MMR) (n.2);
t) Emergency management Center
u) WC and shower rooms;
v) Areas for future expansion;
w) Escape and access stair cores.

3. First Floor (Admin):
a) Office and ancillary areas;
b) Client offices and board rooms;
c) WC and shower rooms;
d) Areas for future expansion;
e) Escape and access stair cores.
f) Technical rooms
g) Storage rooms

4. Roof, Gantry and external plant areas:
a) Ground floor generator plant and standby generator systems;
b) Interface with HV/MV Substation
c) Power Modules for primary, reserve and house electrical systems (installed on ground floor);
d) Mechanical cooling plant and pumps installed on roof gantry;
e) Chilled water buffer vessels on roof gantry;
f) Ancillary rooms for chilled water systems on gantries;
g) External feedar;
h) AHU systems for Data Halls and adjacent areas;
i) AHU systems for ground floor and first floor office accommodation;
j) Toilet supply and extract ventilation systems;
k) DX and VRF cooling systems for electrical rooms and MMR rooms;
l) VRF cooling systems for ground floor and first floor office accommodation;
m) Smoke ventilation plant.

The building in question has been designed to be constructed in distinct and successive phases:
1. Shell & Core construction.
2. Fit-Out.

The Shell & Core phase will involve the structural components of the building (foundations, columns, beams, roof, external walls, internal partitions, external areas, and provisions for electrical and mechanical systems). Subsequently, the construction of the interior works will proceed, including the internal space layout, finishes, and installation of electrical and mechanical systems.

The design has been developed based on a typical module encompassing the space for a pair of data halls and associated structures (Gantry area, MEP Gallery, power module, and generators). Each module includes two IT halls with a capacity of 6 MW each and two IT halls with a capacity of 4MW

each, for a total of 20 MW. This "basic element" has been replicated within the building to achieve the site's overall capacity.

The office block follows a dedicated design based on the internal space layout.

Although the design shall be in accordance with Tier III principles, rather than fault tolerant, the critical distribution associated with the IT load shall be arranged such that redundant services do not pass through the same fire compartment. Corridors and the Data Halls are exempt from this requirement.

The design and subsequent implementation of the systems must take into account the requirements outlined in the structural design, as summarized in the technical report (relazione specialistica).

No specific certifications have been requested for the building; therefore:

- LEED/BREEAM/WELL certification: not required
- UPTIME Institute certification: not required
- ANSI TIA 942 certification: not required

2. CLARIFICATIONS

The descriptions herein specify the minimum required functional performance. The Contractor must carefully review all data and specifications contained in this document, as it will, by contractual obligation, be fully and unconditionally responsible for ensuring the correct operation of the system, guaranteeing compliance with the prescribed operating conditions and requirements.

For topics not addressed or specific details not specified, it is required that the materials used and the execution of the works comply with equivalent European standards and adhere to the standardized dimensions outlined in the applicable UNI and DIN tables.

Additional clauses regarding the relationship between the Client and the Contractor will be defined in the Construction Contract executed with the Client.

Materials for which samples have been requested may not be installed until they are approved by the Work supervision.

The Contractor must not use materials rejected by the Work supervision and is required to remove them from the construction site. The products to be installed must be those specified in the project or, if no specific brand is indicated, those listed in the approved brand catalog.

In the event that the project documentation contains conflicting data or information, the most demanding requirements that favor safety shall be considered.

All works related to the contract shall be carried out by the Contractor in accordance with the requirements and conditions outlined in the project documents. These requirements, however, are not intended to be limiting, as the Contractor expressly undertakes to execute the work to the highest professional standards, in compliance with applicable legal regulations, to deliver a fully operational system included in the offer price. In any case, it is the responsibility and duty of the installer to address any issues arising from the application of evidently incorrect instructions, such as typographical errors, or from the failure to execute critical components for safety. This applies when such errors or omissions are identifiable based on the technical knowledge that the installer is legally required to possess, thereby ensuring the systems' compliance with the highest professional standards.

All works must be coordinated with the execution of other activities, and the construction schedule must be submitted to the Work supervision for approval. During the progress of the work, in line with the requirements of the site and the Client, temporary works may be requested to ensure the operation of existing systems or to enable the provisional functioning of systems covered under this contract. The Contractor will be responsible for maintaining the operation of any active areas that must remain functional throughout the duration of the work.

No modifications to the execution of the planned works may be made by the Contractor without prior written approval and authorization from the Client and the Work supervisor.

Should any personnel be found responsible for actions deemed serious by the Work supervisor, the latter is authorized to order their immediate removal without the Contractor having the right to request an extension of time or claim damages.

By signing the contract, the Contractor indemnifies the Client against any potential claims or actions from subcontractors in the event of disputes between the Contractor and the subcontractor.

All charges and accessories defined in the contractual documents provided by the client are to be considered included in the contract at the expense of the General Contractor.

2.1. General requirements for the execution of works

The CONTRACTOR must verify the presence of pipes and conduits that could be affected by excavation works, ensuring they are out of service and coordinating with the WORK SUPERVISION for any necessary safety measures.

Materials deemed recoverable at the sole discretion of the WORK SUPERVISION must be cleared of mortar, cleaned, and carefully transported to locations specified by the WORK SUPERVISION.

In the event of non-compliance with the above, the CLIENT reserves the right to have the work performed by another company and to charge the costs incurred to the CONTRACTOR. The method and time frame for this process will be determined at the discretion of the WORK SUPERVISION.

The extent of work covered by the specification and drawings includes the detailed design, site surveys, production of co-ordinated working drawings, technical submittals, procurement, supply, delivery, off- loading, positioning, storing, installation, setting to work, testing, commissioning, demonstration and handover of the services, associated controls and ancillary systems as described in the project documents.

The installation shall comprise all materials, labour, cartage, tools, plant, appliances, accessories and fixings necessary for the proper execution of the works, together with all minor and incidental works.

The following identifies the work to be undertaken by the contractor. The listed items are not intended to limit or exclude any items required by the tender documents.

The Contractor shall ensure toilet accommodation as required by Authorities for construction purposes is maintained in a sanitary condition at all times. Make all necessary arrangements for and pay all charges for sewer services.

The Contractor shall provide for temporary lighting and power for the Works, complete with switchboards, switchgear, meters, wiring, etc., and maintained, adapted, enlarged, extended as the need arises in accordance with the requirements of the power utility company and any other Authorities having jurisdiction over the Works.

An adequate level of light intensity shall be provided for performance of work in and about the Site.

The Contractor shall comply with relevant regulations and requirements, pay all fees and charges in connection with temporary lighting and power for the Works and offices, etc., pay for electricity consumed used including for testing of services and installations.

When it becomes imperative to remove temporary electrical installations, permanent circuits may be put into service, after inspection and testing, but in no circumstances shall the warranty period of any item of the electrical installation commence at a date earlier than the Date of Completion.

The Contractor shall provide and use its own lamps at all light outlets required for buildings and allied operations, excepting only for such period immediately prior to handover of buildings as the Employer's Representative may allow permanent lamps provided under the Sub-contract to be used for such purposes. Replacement of lamps or any fittings showing signs of damage shall be carried out at the expense of the Contractor, at the sole discretion of Employer's Representative.

The Contractor shall allow for temporary water service as necessary to carry out its obligations under the Contract. Extend service(s) and also augment the supply if so required, to provide metered supplies for the Works on Site and to make provision for raising water required as needed.

The Contractor shall return the meter(s), stop off service(s) to meet the Water Authority's requirements and remove from the Site the temporary installations and any associated material and equipment when no longer required.

Water drawn from the permanent installations for the Works for testing or other purpose during the Contract period to be metered and paid for by the Contractor.

The Contractor to pay for all water used for the work under the Contract at the Site and all costs and charges for the temporary installations, pipework, etc., meter hire.

Provide temporary fire protection in accordance with the requirements of the Authority having jurisdiction over the works.

The General Contractor must also consider in the contract costs the disposal, according to local regulations, of construction waste, water from the washing of the system, and water from the discharge of installed technological systems not delivered to the Client.

2.1.1. General requirements

The Contractor shall undertake the procurement, manufacture, installation, testing, commissioning, demonstration and disposal, where required, of all materials, equipment, plant and services as detailed within the project documents.

2.1.2. Overview

The contractor shall deliver engineering services to provide complete and fully functioning systems to the building.

The contractor shall furnish, deliver and install all materials, equipment and appurtenances required for a complete installation, including but not limited to pipes, ductwork, ventilation equipment, ancillaries, electrical distribution, containment and supports.

The engineering service works include the principal elements listed below:

1. Mechanical Services;
2. Electrical Services;
3. Public Health Services;
4. Building automation system and BMS;
5. Telecoms Services
6. Security Services
7. Fire Services.

2.1.3. Building services works activities:

1. Issue of technical submittals for all required equipment for Status A approval;
2. Issue of equipment fabrication and wiring diagrams for Status A approval;
3. Review and verification of all engineering systems, and design of specialist systems detailed in CDP section;
4. Obtain Statutory Approvals;
5. Manufacture;
6. Witness factory testing of selected equipment;
7. Supply and Delivery to Site;
8. Erect and Connect-up;
9. Test on Site;
10. Commission;
11. Performance Test;
12. Demonstration;
13. Provide operating and maintenance manuals and record information;
14. Train employer's staff;
15. Handover in full working order.

2.1.4. General

The contractor shall include for the following including specialist design where applicable:

1. Compliance with Building Permit conditions;
2. Plant replacement strategy;
3. Method statements and risk assessments;
4. Application for permits to work and system isolation requests;
5. Modifications to existing services;
6. Factory witness testing;
7. Coordination of installation works including the off-loading, positioning and on-site assembly of all main pre-ordered items of equipment (Power modules, switchgear, Transformers/RMU/MU and generators as required);

8. Installation of all power, controls and earthing cabling for the complete operation and functioning of the power modules, PV installation, MV/LV transformers and MV and LV switchboards);
9. Labelling;
10. Temporary services as required;
11. Employ a specialist commissioning manager;
12. Testing and commissioning (ASHRAE levels 1-5) for all equipment and systems;
13. Development, implementation and execution of an integrated system test (IST) to the client's satisfaction;
14. Decommissioning, removal and disposal of any redundant or temporary equipment;
15. Record documentation;
16. Building logbook;
17. Staff training;
18. Seasonal commissioning checks and adjustments;
19. Miscellaneous works and equipment;
20. Handover including technical cleaning to EN 14644 Level 8;
21. Warranties;
22. Spares. Contractor to propose a spares list;
23. Defects liability.

2.1.5. Electrical services

System topology and shall comprise the provision of the following major items:

1. MV/LV Power module installation
2. LV containerised generators;
3. Multiple LV input switchboards;
4. PV system design and installation;
5. Multiple PV paralleling switchboards;
6. Centralised bulk fuel oil storage system and fuel transfer system;
7. MV cabling;
8. LV cabling;
9. Control and protection cabling;
10. Battery tripping units and distribution;
11. Distribution boards;
12. Power to mechanical, public health and fire services;
13. Power to security and communications services;
14. Power to ancillary services;
15. Small power distribution;
16. Lighting and lighting controls;
17. Access and emergency lighting via centrally monitored and self-contained battery system;
18. Containment for all building services, security and communications;
19. Trace heating;
20. Earthing and bonding;
21. Lightning Protection;

22. Security services.

Refer to schedules and drawings for indicative ratings and quantities of main plant and equipment.

2.1.6. Mechanical services

The mechanical services installation work shall comprise the provision of the following major items:

1. Air cooled chillers with free cooling;
2. Fan Wall Units per Data Hall;
3. CDU Cooling Distribution Units within Data Hall;
4. Ancillary room for chilled water plant, i.e. filters and pressurisation units;
5. Chilled water pipework distribution system;
6. Smoke extract and make up air systems;
7. Fresh air handling units for heating, ventilation and cooling to Data Halls
8. Fresh Air handling units for heating, ventilation and cooling to Landlord and Customer areas within the Admin Block;
9. VRF for heating and cooling to Admin Block and ancillary areas;
10. Distribution ductwork systems including volume control and fire dampers;
11. Air diffusers and grilles;
12. Weather louvres complete, where necessary, with bird mesh screens;
13. Thermal insulation;
14. Leak detection and drips trays;
15. Automatic controls;
16. BMS;

2.1.7. Fire services

The critical building rooms shall have fire suppressions and detections systems:

1. Automatic fire detection and alarm system including interface with fire extinguishing systems, control systems, ventilation systems and BMS;
2. Multi aspirating smoke detection systems;
3. Air quality detection for fresh air intake;
4. Double knock pre-action sprinkler systems to LV switch rooms;
5. Double knock pre-action sprinkler systems to HV substations;
6. Double knock pre-action sprinkler systems to each Data Hall;
7. Dry sprinkler systems to generator room;
8. Wet sprinkler systems to admin block and storages.

2.1.8. Public health

1. Domestic hot water heat pump system;
2. Point of use water heaters to remote appliances;
3. Provision of new above ground drainage to suit sanitary appliances;
4. Water services;
5. Packaged water treatment plant;
6. Lifting pumps;
7. Condensate drainage pipe work.

2.1.9. Automation, control and monitoring

1. Integrated building automation system (BAS) and backbone communications network for monitoring and control of critical systems (see BAS specifications for scope);
2. Building management system (BMS) for the control and monitoring of critical cooling and ventilation infrastructure (see BMS specifications for scope);
3. Electrical management system (EMS) for the monitoring of electrical systems (see EMS specifications for scope);
4. UPS backed HMIs, networking equipment and outstations for all BAS, BMS, EMS systems;
5. Automatic fuel transfer system (FTS) with remote HMIs and manual override panel;
6. Plant and equipment monitoring and alarm management;
7. Interface with fire and security systems;
8. Interface with 22 kV substation PMS;
9. Receipt of a NTP time synchronisation reference from the 22 kV substation NTP server and distribution to all devices and systems on the BAS, BMS, EMS and security networks.

2.1.10. Vertical transportation

Refer to architectural sections for details of vertical transportation required.

2.1.11. Communications

1. Provision of a backbone operations technology (OT) fibre network for building services, including BAS, Security etc;
2. Wireless access points throughout the building and external plant gantries, for systems monitoring purposes;
3. Mobile signal range extenders;
4. Supply, install and configuration of all active hardware, virtual LAN tags, firewalls and proxies;
5. Structured cabling system including voice and data cabling and all passive infrastructure for all systems on site that require IP connectivity;
6. All necessary containment and power supplies, both internal and external;
7. Coordination and arrangement of all external/internal below ground communications ducts.

2.1.12. Security

1. Security provision for all critical areas.
2. External CCTV;
3. Access control;
4. Fully populated Security Operation Centre (SOC);
5. External plant room enclosures;
6. Primary and secondary supports for building services installation;
7. Open mesh grating to the gantry to suit the building services installation;
8. Provision of sleeving and fire stopping to all penetrations with an approved packing system, including future;
9. Louvre screen on gantry;
10. Access stairs and platforms for plant access and maintenance;
11. Provision of future penetrations to operational areas.

2.1.13. Building works in connection

1. All works in connection with the building services installations;
2. External plant room enclosures;
3. Primary and secondary supports for building services installation;
4. Open mesh grating to the gantry to suit the building services installation;
5. Provision of sleeving and fire stopping to all penetrations with an approved packing system, including future;
6. Louvre screen on gantry;
7. Access stairs and platforms for plant access and maintenance;
8. Provision of future penetrations to operational areas;
9. All civil engineering works associated with external and internal below ground services. Note that the internal below ground services have been instructed under a separate contract; the Contractor shall be responsible for coordinating the external to internal below ground services as required to suit the services required under the Contractor's scope.

2.1.14. Energy efficiency

A key aspect of the project is to maximise energy efficiency and products should be selected to minimise energy usage across the range of climatic conditions for the site location.

The contractor shall ensure equipment selections shall be as efficient as possible and wherever possible select equipment from the Energy Technology List to enable the client to benefit from Enhanced Capital Allowances (ECAs). Where equipment is subject to ECAs, the contractor shall provide original invoices/receipts to enable these to be claimed.

IT equipment integral to the design and operation of the inherent building systems e.g. UPS systems, generators, cooling, BMS/EMS, etc, will be procured in accordance with the "EU Code of Conduct on Data Centres" Best practice supplement version 2'.

The peak PUE will be sufficiently low, to ensure that the IT load, as well as all critical and ancillary loads can be supported both by the generator capacity at N and the utility connection.

2.2. Contractor design portion (CDP)

Contractor Designed Portions are elements of the Works that requires design development by the Contractor for:

1. Systems, equipment or facilities that are provided with a performance specification within the Tender Documents.
2. Systems, installations or facilities that require design verification due potential variances during execution of the Works.
3. Systems, installations or facilities whose satisfactory performance is reliant upon criteria ascertained during the construction Works.

The Contractor retains design liability for the CDP elements of the Works scheduled below.

The Contractor must familiarise themselves with the reference standards, specifications and Contract requirements which may expressly identify or infer the Contractors design portions along with the works identified below:

1. Tender Drawings: The tender drawings are generated from a BIM/ Revit model that has been developed to the level of detail in accordance with RIBA Stage 4, Feasible Generic Design to LOD300 to BSRIA BG6 Stage 4a (Feasible Generic). In accordance with BSRIA BG6/2018 – A Design Framework for Building Services. The contractor shall further develop the level of detail to;

a) RIBA Stage 5 level for Shop Drawings
b) RIBA Stage 6 level for As-built Drawings at Handover
c) RIBA Stage 7 level for Record Drawings at completion of the defects period to capture any subsequent changes

Temporary Works: Works that are required to facilitate the Permanent Works.

Builders work: Final coordination of builders work openings, fire stopping, and design responsibility limited to single openings below 250mm.

Structural steelwork frame: The Contractor shall engage a Specialist Supplier/ Sub-Contractor to validate the design intent, modify as necessary and provide additional detailing to provide a structure that is fit for purpose fulfilling the Contract Requirements with respect to load capability, bracing, deflection and frame stability etc. Submit details to the Engineer for approval.

Equipment plinth / base: Contractor to design, supply and install based on equipment final approved selections.

Services brackets, hangers and supports, including secondary steel work;

All secondary/final cable containment

4G/5G telephone system: The contractor is to refer to the initial design that has been prepared by Infrastructure Wireless Italiane (INWIT) for the basis of the costing. The design is performance based and is to be developed by the contractor and INWIT including all power supplies and associated fixings required for the correct operation of the system. The Contractor is to ensure full compliance with local code and EN/UNI standards. Submit details to the Engineer for approval.

Automatic controls including BMS and the main system backbone BAS;

Anti-vibration mounts;

Secondary steelwork to support MEP services: Sizing and selection of cable/ pipe supports, drop rods, secondary containment, secondary steelwork including that for data hall future fit-out containment etc. Submit details to the Engineer for approval.

Fire-fighting systems: The design is performance based, the Contractor is to ensure full compliance with local code and EN/UNI standards and NFPA Standard as indicated in the technical report. Submit details to the Engineer for approval. Contractor to refer to Client Responsibility Matrix.

Diesel fuel system: Note that the design and supply of the fuel system will be by the Generator vendor. However the Contractor shall coordinate with the Vendor's design and shall be responsible for the installation of the entire diesel fuel distribution system ensuring full compliance with local code and EN/UNI standards. Submit details to the Engineer for approval.

Equipment plant replacement strategy in line with final equipment selections, installation and manufacturers recommendations.

Pump heads: Contractor to undertake hydraulic calculations prior to pump procurement to validate pump heads based upon the Contractors proposed, and approved, system configuration.

Pipework expansion/ movement: Contractor to design mitigating pipework expansion/ movement provisions to address thermal expansion and building movement upon supported pipework related to the fire protection systems.

Fan external static pressures: Contractor to undertake external static pressure calculations prior to fan procurement to validate fan ESP's based upon the Contractors proposed, and approved, system configuration.

Trace Heating for all externally exposed pipes. (Fire Protection, condensate drain, water supply, non potable water supply) including calculations, selection, supply, installation, test and commission.

Water treatment system: Stage 4 drawings show design intent only. System shall be designed, installed, tested and commissioned by a specialist contractor. It's contractor responsibility to identify incoming water quality and select proper water treatment equipment to satisfy minimum water quality requirements.

The Technical Standards for Construction ("Norme Tecniche per le Costruzioni - NTC") require the determination of seismic demand for the design of non-structural elements and in particular for elements assembled and installed on site. When installing the equipment and system components and coordinating the necessary accessory works, the Contractor must comply with the requirements of NTC 2018 in relation to the class of use considered for the structural design. The seismic demand emerging from the site seismic hazard and the related response has been studied in detail by the structural engineer, with reference to NTC2018 as per DM 17/01/2018, par. 7.2.3. All regulatory references, technical data, calculation results related to these considerations are to be found in the structural design documents. The contractor is therefore required to consult the latest revision of the tender documents included in the structural design in order to verify their congruence and to correctly dimension the plant engineering building services, and related brackets and handlings and for support and stability.

Seismic provisions: Contractor to design the seismic control provisions, including but not limited to the following as required by the local authority and seismic requirements.

1. Wire sway bracing to fire-fighting pipework.
2. Restraint of fuel system pipework.
3. Restraint of life-safety control panels and equipment to preserve their operation during and after a seismic event.
4. Restraint of electrical panels and other floor standing that pose a risk of injury should they topple during a seismic event.
5. Bracing and restraint for all electrical cable containment and equipment fixings.
6. Associated fire-stopping detailing where lateral movement of the above-mentioned pipework at wall penetrations is required.

2.3. Design of pipework flushing strategy.

Refrigerant pipework and accessories: Contractor to engage a Specialist Supplier to review the refrigeration pipework design and modify as necessary to suit the air-conditioning equipment of the Specialist Supplier to ensure a complete and fully functioning system. Submit details to the Engineer for approval.
Design, supply, install, test and commission VRF systems and fan coil units within front of house spaces including but not limited to electrical connections, controls, sensors, ductworks, refrigerant pipes, insulation, grilles, dampers etc.

The requirement for Leak detection associated with VRF refrigerant system shall be checked and verified by the contractor and their specialist sub-contractors, subsequently any necessary detectors, sounders, and control system shall be installed to ensure full compliance with European F-gas regulations.

The Contractor shall design, supply, install, test and commission leak detection on all critical spaces room, condensate drainage, and refrigerant pipes passing above the critical space.

The Contractor shall provide all necessary support to the Nominated Supplier such as civil work/ scaffolding/ power/ water/ storage for their day-to-day material and installation work. Any civil rectification, if required, to fit the specified equipment will be the responsibility Contractor as part of his coordination responsibilities.

The Contractor shall coordinate directly with the system integrator and shall provide coordinated shop drawings and as-built drawing for the approval of the Engineer. The drawings shall include all details of the equipment and installation details such as cut outs, core drills, power cables and containment, mechanical and electrical connections etc.

The Contractor shall be responsible for coordinating equipment level testing by the Nominated Supplier. The Contractor shall be wholly responsible for functional system testing and integrated system testing to ensure system interfacing and operationally unison in accordance with the sequence of operation.

2.4. Testing, commissioning and setting to work

2.4.1. General

This section shall be read in conjunction with the Project Documents.

The contractor shall appoint a specialist contractor to carry out the testing and commissioning of the various systems.

All systems shall be fully tested and commissioned; however, a proportion of the tests will be conducted in the presence of the client's representative.

All services in voids and raised ceilings shall be signed off by the client's representative prior to closure.

All fire safety systems shall be demonstrated in the presence of the client's representative and the local fire authority, which shall include inspection, releasing and resetting of all fire dampers installed in the ductwork system.
The contractor shall provide attendance on the Electrical Services contractor during the fire alarm testing to confirm the cause and effect operates as required for the mechanical plant.

At the outset of the project the contractor, when programming the works, shall ensure that sufficient time is allocated for the proper testing, commissioning and setting to work of all the systems.

The employer shall engage a specialist company (a Commissioning Agent) to oversee and validate the Contractor commissioning and testing.

The General Contractor shall appoint a company to carry out the onsite management.

The requirements for testing and commission are described in the Client Commissioning documents.

2.4.2. Method statements

For each stage of the commissioning a written method statement shall be submitted by the contractor for comment four weeks prior to the event.

In addition to a detailed schedule of the proposed tests, the method statements shall include methods of connections, test equipment connection plans, time schedule, itinerary for factory tests, tabulated expected results, pre-requisites and a method of recording any corrective actions.

2.4.3. Factory testing

Witness factory testing shall include the following systems

1. Air-cooled chiller with free cooling;
2. Fan Wall Units – one of each type to be factory tested;
3. CDU Units - one of each type to be factory tested
4. Generator – one of each type to be factory tested;
5. Power Module – one of each type to be factory tested;
6. BAS / EMS / BMS graphics;
7. MV switchboard - one of each type to be factory tested;
8. MV/LV transformer;
9. LV switchboard - one of each type to be factory tested.

2.4.4. Site testing

Site testing of equipment shall be carried out prior to commissioning as detailed in the project documents and witnessed by the clients representative.

2.4.5. Commissioning

The contractor shall ensure adequate time is allowed for commissioning the individual parts of the system.

The contractor shall provide a comprehensive commissioning and witnessing plan four weeks in advance of the commissioning period for approval by the Client and Engineer.

2.4.6. Commissioning records

Officially certified commissioning records shall be provided to the client and engineer on completion of the tests.

2.5. Employer's requirements

2.5.1. General requirements

The end requirement is to provide independent data centre buildings within a single secure campus site.

Each building shall be capable of delivering the required IT power to the data centre environment in a secure, resilient manner.

The estate services, including the full perimeter works, remediation, environmental works and site security are to be carried out as part of these works.

Primary electrical power shall be derived from an onsite 22 kV substation switch room complex provided under a separate contract for final day, and from the SES ENEL building for the first data hall.

2.5.2. Scope

The scope for the site shall include but not be limited to the following:

1. The entire perimeter fences;
2. Site clearance and slab break up to allow construction;
3. The site access gates and the control of those gates;
4. Any roadways detailed;
5. All landscaping under footprint;
6. External lighting and security for the site;
7. The full construction of the buildings including the completed structure, foundation, roof, walls and fenestration and the provision of all access and egress, internal walls, circulation and base services;
8. All civils works, drainage, duct laying, trenching, carpark, roads and foundations, balancing and retention ponds and sub structures;
9. Establishment of all incoming utilities to the site and to buildings;
10. Full fitout to a CAT B standard of all client offices, welfare, security rooms, toilets, showers and stores within the building on the ground level;
11. Provision of engineering stores and workshops;
12. The construction of the plant rooms, Data Halls, corridors, security access, tube locks and escape paths;
13. All engineering, fire, lighting and small power required for the landlord systems to support the non- critical elements of the building;
14. All engineering, power, lighting, fire alarm, fire suppression and ancillary services and cable containment provisions required to fully support Data Halls deployment and the critical infrastructure, including all energy metering to comply with all statutory regulations etc;
15. All temporary, or otherwise, services in relation to the fallow areas;
16. All perimeter security including fence, gates and CCTV;
17. All building main security including the full fitout of the security operations centre (SOC);

18. A facilities operations centre (FOC);
19. Provision of plant goods lifts;
20. Provision of passenger lift;
21. All required acoustic treatment;
22. All required fire protection and fire protections systems.

2.6. Project constraints

2.6.1. Building permit status

A building permit has been approved and granted and the engineering services shall be installed and designed in accordance with the planning consent and the schedule for conditions.

It shall be noted that the planning permission has been granted, which places onerous conditions on various aspects of the development, including but not limited to, computer centre deployment, separate systems between computer centres and emissions.

The contractor shall pay particular attention to the requirements of the permit and to ensure that all engineering systems comply with these requirements. The Contractor shall be responsible for compliance and the submitting for all documentation as required to grant permit approval.

This shall include the submittal and responsibility for their success of all necessary statutory legislative/ permitting applications.

The Contractor shall be responsible for submitting updated permitting drawings as required to support any addendums required resulting from the Contractor's detailed design, and for making the necessary applications for completion.

2.7. Incoming utilities and site services

2.7.1. General

For the description of all incoming utilities an site service please refer to the L22 External Services Report and annexes.

2.8. Obligations related to on-site safety

The Contractor, after reviewing the Safety and Coordination Plan (PSC) prepared by the Safety Coordinator during the design phase and inspecting the construction site area, must develop its own Operational Safety Plan (POS). The requirements and activities to be undertaken are outlined in the PSC.

2.9. Coordination with other contractors or entities

The Contractor must provide and receive all relevant or necessary information and data from other contractors (e.g., electrical systems, technological systems, elevators), particularly in cases of potential interferences, connections, or integrations, or where support works (e.g., openings, foundations) are required. The Contractor must prepare a work schedule to define the required information and establish deadlines for its delivery.
The data must be provided in the form of drawings or written communications, with a copy sent to the Work supervision (DL).
Any additional costs arising from delays in the overall installation or general work schedule caused by non-compliance with the above requirements will be charged to the Contractor.
Before starting work and in a timely manner, the Contractor must define, in agreement with the Work supervision, the necessary support works and provide precise drawings and instructions for their execution.

2.10. Testing and sampling of materials, equipment, and system components

The following technical specifications are to be considered as supplementary to those provided in the bill of quantities. In the event of technical discrepancies, the Contractor must adhere to the specifications that ensure the highest standards of technical performance and/or safety (for both people and property).

The Contractor must conduct tests on materials or assembled components when requested by the Client or the Construction Supervision (DL), following the agreed-upon procedures. The results must be communicated in writing to obtain the necessary approval.

The aforementioned tests will be required primarily for materials with insufficient documentation from the manufacturer or supplier, or for solutions and applications involving elements, materials, and components for which a functionality check is deemed necessary before approval for installation.

Tests will be conducted on-site or at another location as agreed.

The Contractor must provide, upon request by the work supervisor and in accordance with agreed-upon procedures, samples of materials, equipment, and/or execution and construction methods for system components.

All samples must be clearly listed and labeled to ensure approval is granted without ambiguity.

If the samples submitted to the work supervisor are not approved, the Contractor must provide additional samples until approval is granted.

Before proceeding with the procurement of all materials, equipment, and components specified in the bill of quantities or otherwise required for installation in the system, the Contractor must submit to the work supervisor for the approval of the technical, performance, and dimensional characteristics of the components. The work supervisor will provide a response within 14 days. The approval process will follow these steps:

- Submission of material samples.
- Transmission of the technical data sheets for the material or component, with the technical specifications clearly highlighted.
- Submission of the document, including all attachments, to the work supervisor.
- Preparation of a mock-up, if requested by the work supervisor.
- Implementation of any required modifications, integrations, or substitutions until final approval is obtained from the work supervisor.

2.11. Electrical services for mechanical equipments

This includes all operations required to ensure the system is fully operational.

The Contractor must carry out the electrical wiring (including associated containment and support systems) for the electrical equipment related to the mechanical systems. This will include:

- A series of dedicated circuits;
- Required isolators and switching devices;
- All cabling from the electrical panel to the isolators/equipment;
- Final wiring and connection between isolators and equipment/systems;
- All necessary containment and support structures.

Refer to the attachment *Annex 00 – Electrical Services for Mechanical Equipments.*

3. TESTING AND COMMISSIONING

The systems in question must undergo a series of inspections and tests over time to verify full compliance with the technical specifications and to ensure their proper functionality.

This section outlines the tests and inspections that must be carried out by the Contractor.

The results of the tests must be recorded on forms approved by work supervisor and must include the corresponding references to the "as-built" drawings. The forms must, at a minimum, include the following information: the date of the test, the individuals present, the measured quantities, the recorded values, the design or limit values, and the instruments used. The forms must be signed by the operator who performed the tests and countersigned by the work supevisor.

The inspector will verify functional compliance with the project and, at their discretion, may repeat the most critical tests in the presence of the Contractor.

Tests and inspections, both during construction and during commissioning, for the heating and air conditioning systems must be conducted in compliance with the following standards:

- UNI 5364 September 1976: "Hot water heating systems, rules for bid submission and testing";
- UNI 10339 June 1995: "Air handling systems for comfort purposes, general provisions – classification and requirements, rules for bid requests, submission, orders, and supply";
- "Testing standards for heating and air conditioning systems developed by the College of Engineers of Milan."
- Additionally, regarding compliance with Law No. 615 and related regulations, the contractor must ensure that testing of all relevant components is carried out by ISPESL, at their own expense and responsibility, obtaining the corresponding certificate.
- Tests and inspections, both during construction and during commissioning, for plumbing systems must comply with applicable standards and regulations (including the water utility provider, Health Department, Fire Brigade, ISPESL, and C.E.I.) and must follow the methods outlined in the following standards:
    - UNI 9182: "Cold and hot water supply and distribution systems. Design, testing, and management criteria";
    - UNI EN 12056: "Gravity drainage systems inside buildings."

The requirements above, and those described in further detail below, must be performed in addition to the Commissioning Process as outlined in the technical report.

3.1. Preliminary inspection

The preliminary inspection, primarily consisting of visual examinations, must ensure that the assembly of the various system components has been executed to the highest professional standards, that the connections between equipment and piping are perfectly sealed, and that everything complies with the specifications outlined in the contract.
Visual inspections of the systems will be carried out with a particular focus on:

- Analysis of the schematics and installation plans
- Verification of the existence, proper drafting, and completeness of the essential documentation required for testing, operation, and maintenance.
- Inspection of the condition, functionality, and accessibility of the systems
- Preliminary confirmation of the complete and operational execution of all systems and their compliance with the project and contract specifications.

3.2. Tests and inspections during construction

This includes all operations required to ensure the system is fully functional, such as water circuit balancing, air distribution balancing and calibration, adjustment calibration, and verifying the operation of equipment under the specified conditions.
Piping must be blown out or flushed to remove grease, foreign objects, and other debris. This process must continue for a sufficient period to ensure the entire system is thoroughly cleaned.

The following outlines the methods and operations necessary to carry out the tests and inspections required to guarantee the proper functioning of the systems. At the conclusion of each inspection, the contractor's representative must complete a specific form documenting the outcome of each individual test. In the event of leaks or faults, the corrective actions taken to resolve the issue must be recorded.

3.2.1. Heating and air conditioning systems

a) Hydraulic test: This test should be performed progressively as the systems are installed, and in any case, once the systems are completed, prior to conducting the tests described in sections b) and c).
The test will be considered successful if no leaks or deformations occur. General pressure tests on hydraulic circuits will be carried out at a test pressure equal to 1.5 times the operating pressure (PN10), maintaining the system under pressure for a minimum of 2 hours.
b) Preliminary tests for circulation, sealing, and expansion using heating and cooling fluids after the test referred to in letter a) has been performed.
For hot water systems, the water temperature in the distribution networks and user appliances must be raised to 85°C.
For superheated water networks and systems, if present, the water temperature must be raised to the design temperature.
The test results will be considered positive only when, in all points of the networks and in the user appliances, the water reaches the prescribed temperature, the return lines are equally heated, no leaks or permanent deformations occur due to expansion, and the expansion vessels adequately accommodate the volume variations of the water within the system.
For cooling fluids, the test will involve verifying proper circulation and the efficiency of the expansion vessel.
It must be ensured that all pipelines can be emptied and air can be vented from the highest points.

c) For winter conditioning and air ventilation systems, after completing the tests referred to in letter b), **preliminary test of air circulation** will be conducted by raising the water temperature to the maximum specified values.
d) For summer air conditioning systems, after completing the tests referred to in points b) and c), a **preliminary test of cooled air circulation** will also be conducted by adjusting the temperature of the cold water circulating in the coils to the values corresponding to the system's maximum load.
e) The **airflow rates at the supply outlets**, return inlets, and diffusers will be verified. Where necessary, system calibration will be carried out.
f) **The conditioning units, air handling units, and fans** must be operated for a sufficient period to allow for system balancing and the removal of dirt and dust from the ducts and equipment. During this period, temporary filters, to be provided at the installer's expense, will be employed. This operation will generally take place prior to the installation of diffusers and outlets.
For components subject to applicable regulations (e.g., U.S.L.L., I.S.P.E.S.L., Labor Inspectorate, etc.), the Contractor must ensure that all necessary tests and inspections are carried out to obtain authorization for regular operation.
All the aforementioned tests must be performed in the presence of the Contractor, and a dedicated report will be prepared for each.
It is understood that, regardless of the favorable outcome of the preliminary tests and inspections, the Contractor will remain responsible for any deficiencies identified subsequently, even after commissioning and until the end of the warranty period.

3.3. Final testing

Once the preliminary operations have been completed, the final testing will be carried out to verify the proper functioning of the system and its compliance with the prescribed requirements.
Where applicable, the current UNI standards will govern the testing procedures.
For systems involving air conditioning or seasonal operation, both summer testing and winter testing will be conducted.

3.3.1. Winter testing

The winter testing will take place during the upcoming winter season following the acceptance of the system and the preliminary testing operations, typically within the period between December 10 and February 28.
The testing start date must be at least two months after the completion of the building.

3.3.2. Summer testing

The summer testing will take place during the upcoming summer season following the acceptance of the system and the preliminary testing operations, typically within the period between June 15 and August 30.
The testing start date must be at least two months after the completion of the building.

3.3.3. Measurement parameters

The measurements will include:
- Temperature measurements

- Relative humidity measurements
- Air velocity measurements
- Flow rate measurements
- Noise level measurements
- Any additional supplementary measurements

3.3.3.1. Temperature measurements

Temperature measurements must be carried out using instruments with a sensitivity sufficient to detect temperature variations of 0.25°C.
The measurements will include:

- External temperature
- Internal temperature

3.3.3.2. External temperature measurements

In the tests related to winter operation, for external temperature and unless explicitly indicated otherwise, the average will be calculated based on the following 4 temperatures measured on the northern side of the building, using a thermometer shielded from radiation and positioned 2 meters away from the building wall, over the 24 hours preceding the test. Specifically, this period will be from the time when the internal temperature measurements are started to the same time on the previous day: the maximum, the minimum, the temperature at 8:00 a.m., and the temperature at 7:00 p.m.
In the tests related to summer operation, unless explicitly indicated otherwise, the average of the external temperature will be recorded in the shade during the same period as the internal temperature measurements. These measurements will be carried out once the system has reached steady-state conditions, during the hottest hours of the day, from 12:00 p.m. to 4:00 p.m.

3.3.3.3. Internal temperature measurements

The internal temperature must be measured in the central part of the rooms at a height of 1.50 meters from the floor, ensuring that the sensitive part of the instrument is shielded from the influence of any significant radiant effects.
The tolerance for the measured temperature values, compared to those specified in the contract, will be +/- 1.0°C unless explicitly indicated otherwise.
Temperature uniformity will be verified by checking the temperature differences observed between any point in the area occupied by people and the internal temperature as defined above.
The difference between values obtained from measurements taken simultaneously within the same room must not exceed 1°C.
The difference between values obtained from measurements taken simultaneously in multiple rooms served by the same system must not exceed 1°C in winter and 2°C in summer.

3.3.3.4. Relative humidity measurements

Relative humidity must be measured using a ventilated psychrometer.

Each of the two thermometers on the instrument must have a sensitivity sufficient to detect temperature variations of 0.25°C.
The tolerance for the relative humidity values inside the rooms, compared to those specified in the contract, will be +/- 5% unless explicitly indicated otherwise.
The measurement of external relative humidity must be carried out at the same location where the temperature is measured and simultaneously with the measurements of internal temperature and relative humidity.

3.3.3.5. Air velocity measurements

The air velocity values in the area occupied by people must be measured using instruments capable of ensuring an accuracy of 5%. Unless explicitly indicated otherwise, the air velocity in the area occupied by people must not exceed 0.25 m/s.

3.3.3.6. Airflow measurements

Airflow measurements must confirm that the quantities of air supplied to a given room match the predetermined or guaranteed values.
Specifically, it must be verified that the quantity of external ventilation air is not below the established minimum limits.
Airflow measurements must be conducted in a section of the duct where the airflow is as parallel as possible.
For these measurements, hot-wire or vane anemometers will be used when an accuracy of 10% is sufficient. For higher precision, Venturi tubes or Pitot-Prandtl tubes will be employed.
In all cases, airflow measurements will be repeated multiple times for each assessment.

3.3.3.7. Additional supplementary measurements

In specific cases, as explicitly indicated in the contract or requested by the Inspector for the Client's requirements, the following additional measurements may be performed:

- Measurement of filter efficiency
- Measurement of small pressure differences
- Measurement of flow rates for various types of fluids
- Measurement of fluid temperatures
- Measurement of heat generator efficiency

3.4. Subsequent tests

The systems in question must undergo a series of tests over time to ensure full compliance with the technical specifications as well as their actual functionality.
The methods and timing for conducting these tests are defined in the previous section.
The specified tests must be carried out during the execution of the works and, in any case, within one month of the installation and adjustment of each individual part of the system. These tests include:

3.4.1. Visual inspections

Visual inspections of the systems will be conducted with particular attention to the following:

- Analysis of diagrams and installation plans.
- Verification of the existence, proper drafting, and completeness of essential documentation required for testing, management, and maintenance purposes.
- Assessment of the structure, functionality, and accessibility of the systems.
- Preliminary verification of the complete and operational execution of all systems and their compliance with the project specifications and contractual requirements.
- Inspection of insulation and enclosures.
- Verification of the adequacy of safety measures against the risk of direct contact with live components.
- Inspection of the functionality of protective measures in areas accessible only to trained personnel.
- Verification of the adequacy of safety measures against the risk of direct contact with live components during operations reserved for trained personnel in segregated areas.
- Verification that equipment and machinery, unless subject to specific testing, have functional and dimensional characteristics compliant with the specifications and/or standards.
- Assessment of the ability to safely perform maintenance and to promptly act on the power supply to eliminate hazards arising from abnormal operation of devices or machinery.
- Inspection of the adequacy and functionality of machine control panels.

3.5. Inspections and tests during construction

These are the tests and inspections to be conducted on materials and parts of the system once the work is completed, without performing any destructive interventions. These include:

3.5.1. Hydraulic and leak tests

Hydraulic tests and leak tests must be conducted as specified in the relevant requirements for the piping systems.

3.5.2. Fluid circulation tests

The tests involve verifying the circulation of various fluids, as well as the air passing through the different circuits and outlets. The tests must ensure:

- The perfect sealing of pipes and ducts and the maintenance of their regular configuration even under maximum variations of temperature and pressure.
- The supply of all equipment and air outlets with the calculated flow rates, temperatures, and pressures.
- The ability to drain all pipelines and release air from the highest points.

- The cleanliness of the pipes and ducts.
- The correct calibration of the components selected to balance the various circuits.
- The proper calibration and regular operation of the automatic regulation devices.

3.6. Testing and measurement for final commissioning

The measurements and tests include:

- Temperature measurements
- Relative humidity measurements
- Air velocity measurements
- Flow rate measurements
- Noise level measurements
- Cold water supply test
- Hot water supply test
- Test of circulation and insulation of the hot water distribution network under zero delivery conditions
- Verification of hot water supply capacity
- Evacuation test
- Odor leakage test
- Performance evaluation of equipment

3.6.1. Temperature measurements

Temperature measurements must be carried out using instruments with a sensitivity sufficient to detect temperature variations of 0.25°C and capable of daily and weekly recording.
The measurements include:

- External temperature
- Internal temperature
- Fluid temperature

3.6.1.1. External temperature measurements

For tests related to winter operation, unless explicitly indicated otherwise, external temperatures must be recorded starting 24 hours prior to the internal temperature measurements. The measurements must be taken on the northern side of the building using a thermometer shielded from radiation and positioned 2 meters away from the external wall.
For tests related to summer operation, unless explicitly indicated otherwise, external temperatures must be recorded in the shade during the same period as the internal temperature measurements. These measurements are carried out once the system has reached steady-state conditions, during the hottest hours of the day, from 12:00 p.m. to 4:00 p.m.
If the external thermohygrometric conditions specified in the contract are not met during the commissioning tests, the detailed provisions outlined in sections 3.2.2.1, 3.2.2.2, and 3.2.3 of the aforementioned UNI 5104 standards must be followed.

3.6.1.2. Internal temperature measurements

Internal temperature must be measured in the central part of the rooms at a height of 1.50 meters from the floor, ensuring that the sensitive part of the instrument is shielded from the influence of any significant radiant effects.
The tolerance for the measured temperature values compared to those specified in the contract is ± 0.5°C in winter and ± 1°C in summer, unless explicitly indicated otherwise.
Temperature uniformity is verified by checking the differences between the temperature at any point in the area occupied by people and the internal temperature as defined above.
The difference between values resulting from simultaneous measurements within the same room must not exceed 1°C.
The difference between values resulting from simultaneous measurements in multiple rooms served by the same system must not exceed 1°C in winter and 2°C in summer.
For at least 20% of the rooms, a 24-hour temperature recording must be conducted.

3.6.1.3. Relative humidity measurements

Relative humidity must be measured using a ventilated psychrometer. Each of the two thermometers on the instrument must have a sensitivity sufficient to detect temperature variations of 0.25°C.
The tolerance for the relative humidity values inside the rooms, compared to those specified in the contract, is ± 5%, unless explicitly indicated otherwise.
The measurement of relative humidity inside the rooms must follow the same guidelines as those applicable to temperature measurements.
The measurement of external relative humidity must be carried out in the same location as the temperature measurement and simultaneously with the internal temperature and relative humidity measurements.

3.6.1.4. Air velocity measurements

The air velocity values in the area occupied by people must be measured using instruments capable of ensuring an accuracy of ± 5%.
Unless explicitly indicated otherwise, the air velocity in the area occupied by people must not exceed 0.15 m/s at any point.

3.6.2. Flow rate measurements

Flow rate measurements must ensure that the airflow rates for a given room correspond to the predetermined or guaranteed values.
In particular, it must be verified that the external ventilation airflow rate is not below the established limits.
Flow rate measurements must be performed in a section of the duct where the airflow is as parallel as possible.
For the measurements, hot-wire or vane anemometers may be used when an accuracy of 10% is sufficient. Venturi or Pitot-Prandtl tubes should be employed when greater precision is required.
In all cases, flow rate measurements must be repeated at least twice for each reading.

The openings created for the tests must remain accessible even after the commissioning process to allow for potential future recalibrations. These openings must be properly sealed to ensure airtightness and maintain thermal insulation while also allowing for future inspection. The spacing between openings must comply with applicable regulations.

The following positions are recommended for test points:

Object	Position/Quantity
Fans	Both sides
Filters	Both sides
Dampers	One side, to verify their adjustment
Duct branches	At each damper, to perform balancing
Hydronic terminals	For each terminal
Air terminals	For each terminal

3.6.3. Noise level measurements

3.6.3.1. Instrumentation

Sound level meters must have characteristics that comply with those specified for "precision sound level meters" by the "International Electrotechnical Commission" (I.E.C.), standard 651 type 1, or by the "American National Standards Institute" (A.N.S.I.), S1.4-1971 type 1.
The sound level meter must be equipped with a filter bank for octave bands with central frequencies: 31.5 / 63 / 125 / 250 / 500 / 1,000 / 2,000 / 4,000 / 8,000 Hz.
The sound level meter must be calibrated at the beginning and at the end of each series of measurements.
Measurement Methods and Criteria

3.6.3.2. General methods for measuring internal noise

Measurements must be carried out according to the UNI 8199 standard, "On-site measurement and evaluation of noise produced in rooms by heating, air conditioning, and ventilation systems." To reduce or eliminate disturbances caused by standing waves, it is recommended to perform at least three measurements while rotating the microphone along quarter circles with a radius of 0.5 m in both directions.

Any background noise measurements must be performed in accordance with the definitions and requirements specified in the cited standard, using the following procedures:

- Use a sound level meter with an A-weighting curve and a "fast" time constant.
- Measure and record the weighted sound level every 10 seconds over a total of 12 measurements, using a stopwatch or timer.
- The background noise level is the value exceeded or equaled in 90% of the measurements.

3.6.3.3. General methods for measuring noise toward the exterior

Measurements must be conducted in accordance with DPCM (Decree of the President of the Council of Ministers) dated March 1, 1991.

3.6.3.4. Cold water supply test

The test must be conducted for a minimum duration of 30 consecutive minutes while operating all the supply outlets considered in the calculations simultaneously.
The test is considered successful if, during this period, the water flow from each outlet remains within the calculated values with a tolerance of ±10%.

3.6.3.5. General methods for measuring noise toward the exterior

Measurements must be conducted in accordance with DPCM March 1, 1991.

3.6.3.6. Cold water supply test

The test must be conducted for a minimum duration of 30 consecutive minutes while operating all the supply outlets considered in the calculations simultaneously.
The test is considered successful if, during this period, the water flow from each outlet remains within the calculated values with a tolerance of ±10%.

3.6.3.7. Hot water supply test

The test must be conducted for a minimum duration of 60 minutes or a longer duration if agreed upon with the project management, depending on the service requirements, while operating all the supply outlets considered in the calculations except one.
The test is considered successful if, during this period, from the other outlets operated one at a time in succession, hot water is supplied at the calculated flow rate with a tolerance of ±10% and at the specified temperature after the first 1.5 liters, with a tolerance of ±1°C.

3.6.4. Circulation and insulation testing of the hot water distribution network

The purpose of this test is to verify the proper functioning of the hot water distribution network and the efficiency of the pipe insulation.
The test, preferably conducted during the coldest period of the year, is considered successful if the temperature difference between the hot water supply at the preparatory system and the farthest branch of the network is less than or equal to 2°C.

3.6.5. Verification of hot water supply capacity

The verification process involves simultaneously operating all hot water outlets specified in the design calculations.
The test is considered successful if water is supplied continuously for the guaranteed duration, which must be no less than two hours, under the specified flow rate and temperature conditions, within the previously defined tolerances.

3.6.6. Drainage test

This test must be performed after the system installation is complete by simultaneously discharging water through each column in accordance with the calculated maximum concurrent flow rate. During the test, which can be combined with the cold water supply test, it must be confirmed that water is evacuated smoothly without backflows, bubbling, or flow irregularities. Specifically, it must be verified that light objects, such as crumpled paper, cork stoppers, cigarette butts, matches, or similar items, can be removed effectively from the vessels.

3.6.7. Odor tightness test

This test is conducted once all sanitary fixtures have been fully installed and all traps are filled with water. Using smoke cartridges and maintaining a pressure of 250 Pa, it must be ensured that no smoke odors infiltrate the interior spaces where the fixtures are installed.

3.6.8. Equipment performance

The performance verification of the equipment includes tests and measurements as prescribed in the relevant technical specifications.

4. TECHNICAL REFERENCE STANDARDS

The system shall be designed and constructed in accordance with the latest principles of engineering practice and in compliance with the applicable standards and regulations. The following standards, among others, must be observed:

For the general design approach and criteria:

- Legge 1° marzo 1968 n.186 - Disposizioni concernenti la produzione di materiali, apparecchiature, macchinari, installazioni e impianti elettrici ed elettronici
- D.M. 37/2008 - Regolamento concernente l'attuazione dell'art. 11-quaterdecies, comma 13, lettera a) della legge n° 248 del 2 dicembre 2005, recante riordino delle disposizioni in materia di attività di installazione degli impianti all'interno degli edifici
- D.lgs. 81/2008 - Attuazione dell'articolo 1 della legge 3 agosto 2007, n. 123, in materia di tutela della salute e della sicurezza nei luoghi di lavoro"
- D.lgs. 106/2009 - Disposizioni integrative e correttive del decreto legislativo 9 aprile 2008, n. 81, in materia di tutela della salute e della sicurezza nei luoghi di lavoro
- D.lgs. 27 gennaio 2010, n. 17 - Attuazione della direttiva 2006/42/CE, relativa alle macchine e che modifica la direttiva 95/16/CE relativa agli ascensori.

For the General Characteristics of the System:

- D.lgs. 6 settembre 2005, n. 206 - Codice del consumo, a norma dell'articolo 7 della legge 29 luglio 2003, n. 229 (ex D.P.R. 224/88);
- Direttive CEE 89/392, 91/368, 93/44, 93/68, 2006/42 meglio conosciute come "Direttive macchine" concernenti il ravvicinamento delle legislazioni degli stati membri relative alle macchine;
- D.lgs. 27 gennaio 2010, n. 17 - Attuazione della direttiva 2006/42/CE, relativa alle macchine e che modifica la direttiva 95/16/CE relativa agli ascensori.
- D.P.R. n. 392 del 18.04.1994 - Regolamento recante disciplina del procedimento di riconoscimento delle imprese ai fini dell'installazione, ampliamento e trasformazione degli impianti nel rispetto delle norme di sicurezza;
- Legge 13/7/1966 n.615 – Provvedimenti contro l'inquinamento atmosferico;
- DPR 22/12/1970 n.1391 – Regolamento per l'esecuzione della legge 13/7/1966 n.615 recante provvedimenti contro l'inquinamento atmosferico in particolare al settore degli impianti termici;
- DM 1/12/1975 – Norme di sicurezza per apparecchi contenenti liquidi caldi sotto pressione;
- DM 27/9/1965 – Determinazione delle attività soggette alle visite di prevenzione incendi;
- DM 16/2/1982 – Modificazioni al DM 27/9/1965;
- Circolare del Ministero dell'Interno, Direzione Generale Protezione civile e dei Servizi Antincendio 25/11/1969 n.68 – Norme di sicurezza per impianti termici a gas di rete;

- DL 6/12/1971 n.1083 – Norme per la sicurezza dell'impiego del gas combustibile e relativi decreti di approvazione;
- L. 9 gennaio 1991 n. 10 (con decreti e norme collegate) - Norme per l'attuazione del Piano energetico nazionale in materia di uso razionale dell'energia, di risparmio energetico e di sviluppo delle fonti rinnovabili di energia;
- D.lgs. 19 agosto 2005 n. 192 – Attuazione della direttiva 2002/91/CE relative al rendimento energetico nell'edilizia;
- D.lgs. 29 dicembre 2006 n. 311 – Disposizioni correttive ed integrative al D.lgs. 19 agosto 2005 n. 192, recante attuazione della direttiva 2002/91/CE, relativa al rendimento energetico nell'edilizia;
- D.P.R. 2 aprile 2009 n.59 – Regolamento di attuazione dell'articolo 4, comma 1, lettera a) e b) del decreto legislativo 19 agosto 2005, n.192, concernente attuazione della direttiva 2002/91/CE sul rendimento energetico in edilizia;
- D.M. 26 GENNAIO 2010 – Aggiornamento del decreto 11 marzo 2008 in materia di riqualificazione energetica degli edifici;
- D.LGS. 3 marzo 2011 n.28 – Attuazione della direttiva 2009/28/CE sulla promozione dell'uso dell'energia da fonti rinnovabili, recante modifica e successiva abrogazione delle direttive 2001/77/CE e 2003/30/CE;
- Decreto interministeriale 26 giugno 2015 - Adeguamento linee guida nazionali per la certificazione energetica degli edifici;
- D.P.R. n. 412 del 26.08.1993 - Regolamento recante norme per la progettazione, l'installazione, l'esercizio e la manutenzione degli impianti termici degli edifici ai fini del contenimento dei consumi di energia, in attuazione dell'art. 4 comma 4, della Legge 09.01.1991, n. 10 e s.m.i.;
- Decreti regionali Lombardia su efficienza energetica (DGR VIII/8745 del 22 dicembre 2008, DGR 5796 del 11 giugno 2009, DGR 3868 del 17 luglio 2015, DGR 6480 del 30 luglio 2015, Decreto n.2456 del 8 marzo 2017 e s.m.i.);
- D.P.C.M. 1 marzo 1991 - Limiti massimi di esposizione al rumore negli ambienti abitativi e nell'ambiente esterno e s.m.i.;
- D.P.C.M. 14/11/1997 – Determinazione dei valori limite delle sorgenti sonore;
- L. 28 dicembre 1993 n. 549 - Misure a tutela dell'ozono stratosferico e dell'ambiente e s.m.i.;
- DM 24 novembre 1984 - Norme di sicurezza antincendio per il trasporto, la distribuzione, l'accumulo e l'utilizzazione del gas naturale con densità non superiore a 0,8 e relativi regolamenti di esecuzione e circolari di istruzione;
- D.M. 12 aprile 1996 - Approvazione della regola tecnica di prevenzione incendi per la progettazione, la costruzione e l'esercizio degli impianti termici alimentati da combustibili gassosi;

- DM 20 Dicembre 2012 - Regola tecnica di prevenzione incendi per gli impianti di protezione attiva contro l'incendio installati nelle attività soggette ai controlli di prevenzione incendi;
- Regio Decreto n. 1775 del 11/12/1933 - Approvazione del testo unico delle disposizioni di legge sulle acque e successive modifiche e integrazioni;
- Legge n.896 /1986 - Disciplina della ricerca e della coltivazione delle risorse geotermiche e successive modifiche e integrazioni;
- Decreto Legislativo n.152 del 03/04/2006 - Norme in materia ambientale e successive modifiche e integrazioni;
- D.M. n. 443 21/12/1990 - Regolamento recante disposizioni tecniche concernenti apparecchiature per il trattamento domestico di acque potabili;
- D.lgs. 02.02.2001, n. 31 Attuazione della direttiva 98/83/CE relativa alla qualità delle acque destinate al consumo umano.
- D.M. 06.04.2004, n. 174 - Regolamento concernente i materiali e gli oggetti che possono essere utilizzati negli impianti fissi di captazione, trattamento, adduzione e distribuzione delle acque destinate al consumo umano;
- D.M. 19/09/1959 - Attribuzione dei compiti e determinazione delle modalità e delle documentazioni relative all'esercizio delle verifiche ed ai controlli previsti dalle norme di prevenzione degli infortuni sul lavoro;
- Circolare Ministero del Lavoro n. 800/I del 05/07/1960 prevenzione infortuni - verifiche e controlli.
- Decreti regionali Lombardia relativi agli scarichi (Regolamento regionale 23 novembre 2017, n. 7; Regolamento regionale 29 marzo 2019 - n. 6; Regolamento regionale 19 aprile 2019 - n. 8 e s.m.i.)
- Regolamenti e specifiche degli Enti gestori di servizi (Acquedotto, Aem, Enel, Telecom, etc.);
- Regolamento d'igiene locale;
- Regolamento edilizio locale;
- Decreti regionali Lombardia;
- Prevenzione infortuni (denunce e verifiche);
- Norme U.N.I. (Unificazione Italiana) e CTI (Comitato Termotecnico Italiano)
- Norme C.E.I. (Comitato Elettrotecnico Italiano)
- Norme EN emanate dal CEN, Comitato Europeo di Normazione;
- Norme emanate da ISO, International Standard Organization;
- Norme e Standards emanate da EUROVENT, European Committee of Air Handling and Air Conditioning Equipment Manufacturers;
- Norme e Standards emanate da ASHRAE, American Society of Heating Refrigerating and Air Conditioning Engineers (Atlanta, Georgia - USA);

- Norme e raccomandazioni degli enti o società erogatori di servizi (acqua, gas, energia elettrica, comunicazioni, etc.);

Per le caratteristiche dei prodotti:

- Tutti i componenti utilizzati dovranno essere nuovi di fabbrica, rispondere alle rispettive norme di prodotto, possedere marchio CE e dovranno essere conformi alle norme CEI in vigore od ad equivalenti europee.
- Prescrizioni I.S.P.E.S.L. (ex Ente Nazionale Prevenzione Infortuni ed ex A.N.C.C.);
- Prescrizioni e raccomandazioni del locale Comando dei Vigili del Fuoco e tutte le Norme e Leggi di Prevenzione Incendi;
- Normative e raccomandazioni dell'A.S.L.;
- Eventuali prescrizioni particolari emanate dalle Autorità locali;
- Norme ed istruzioni dei fabbricanti dei componenti.
- Altre normative, aventi valore di legge, relative ai singoli componenti degli impianti, anche se non espressamente richiamate, devono essere rigorosamente applicate.

Below is a list (not exhaustive) of the main UNI reference standards:

UNI reference standards for heating and air conditioning systems

UNI EN 442-1 :2015	Radiatori e convettori. Parte 1: Specifiche tecniche e requisiti
UNI EN 442-2 :2015	Radiatori e convettori. Parte 2: Metodi di prova e valutazione
UNI EN 1264-1:2021	Sistemi radianti alimentati ad acqua per il riscaldamento e il raffrescamento integrati nelle strutture - Parte 1: Definizioni e simboli
UNI EN 1264-2 :2021	Sistemi radianti alimentati ad acqua per il riscaldamento e il raffrescamento integrati nelle strutture - Parte 2: Riscaldamento a pavimento: metodi per la determinazione della potenza termica mediante metodi di calcolo e prove
UNI EN 1264-3 :2021	Sistemi radianti alimentati ad acqua per il riscaldamento e il raffrescamento integrati nelle strutture - Parte 3: Dimensionamento
UNI EN 1264-5 :2021	Sistemi radianti alimentati ad acqua per il riscaldamento e il raffrescamento integrati nelle strutture - Parte 5: Determinazione della potenza termica di riscaldamento per pareti e soffitti e di raffrescamento per pavimenti, pareti e soffitti
UNI EN 1443 :2019	Camini. Requisiti generali.
UNI EN 1751 :2014	Ventilazione degli edifici - Dispositivi per la distribuzione dell'aria - Prove aerodinamiche delle serrande e delle valvole
UNI EN 1859 :2013	Camini - Camini metallici - Metodi di prova
UNI EN 1946-1 :2001	Prestazione termica di prodotti e componenti per edilizia. Criteri specifici per la valutazione dei laboratori che effettuano la misurazione delle proprietà di scambio termico. Criteri comuni.

UNI EN 1946-4 :2005	Prestazione termica di prodotti e componenti per edilizia. Criteri specifici per la valutazione dei laboratori di misurazione delle proprietà di trasmissione del calore. Parte 4: Misurazioni mediante metodi della doppia camera
UNI EN 1946-5 :2005	Prestazione termica di prodotti e componenti per edilizia. Criteri specifici per la valutazione dei laboratori di misurazione delle proprietà di trasmissione del calore. Parte 5: Misurazioni mediante metodi per prove a simmetria cilindrica.
UNI 5364 :1976	Impianto di riscaldamento ad acqua calda. Regole per la presentazione dell'offerta e per il collaudo
UNI EN ISO 6946 :2018	Componenti ed elementi per edilizia - Resistenza termica e trasmittanza termica - Metodo di calcolo
UNI 7129-(tutte):2015	Impianti a gas per uso domestico e similari alimentati da rete di distribuzione - Progettazione e installazione
UNI EN ISO 7730 :2006	Ergonomia degli ambienti termici - Determinazione analitica e interpretazione del benessere termico mediante il calcolo degli indici PMV e PPD e dei criteri di benessere termico locale
UNI EN ISO 7933 :2023	Ergonomia dell'ambiente termico. Determinazione analitica ed interpretazione dello stress termico da calore mediante il calcolo della sollecitazione termica prevedibile.
UNI 8199 :2016	Acustica in edilizia - Collaudo acustico di impianti a servizio di unità immobiliari - Linee guida contrattuali e modalità di misurazione all'interno degli ambienti serviti
UNI 8364-1 :2007	Impianti di riscaldamento. Controllo e manutenzione.
UNI 8364-2 :2007	Impianti di riscaldamento. Controllo e manutenzione.
UNI 8364-3 :2007	Impianti di riscaldamento. Controllo e manutenzione.
UNI EN ISO 8996 :2022	Ergonomia dell'ambiente termico. Determinazione del metabolismo energetico.
UNI 9165 :2020	Reti di distribuzione del gas - Condotte con pressione massima di esercizio minore o uguale a 5 bar - Progettazione, costruzione, collaudo, conduzione, manutenzione e risanamento
UNI EN ISO 9488 :2022	Energia solare. Vocabolario.
UNI EN ISO 9920 :2009	Ergonomia degli ambienti termici. Valutazione dell'isolamento termico e della resistenza evaporativa dell'abbigliamento.
UNI EN ISO 10077-1 :2018	Prestazione termica di finestre, porte e chiusure oscuranti. Calcolo della trasmittanza termica. Parte 1: Generalità
UNI EN ISO 10211 :2018	Ponti termici in edilizia. Calcolo dei flussi termici e delle temperature superficiali. Ponti termici lineari.
UNI 10339 :1995	Impianti aeraulici a fini di benessere. Generalità, classificazione e requisiti. Regole per la richiesta d'offerta, l'offerta, l'ordine e la fornitura
UNI EN 16798-1: 2019	Prestazione energetica degli edifici - Ventilazione per gli edifici - Parte 1: Parametri di ingresso dell'ambiente interno per la progettazione e la valutazione della prestazione energetica degli edifici in relazione alla qualità dell'aria interna, all'ambiente termico, all'illuminazione e all'acustica - Modulo M1-6
UNI EN 16798-3: 2018	Prestazione energetica degli edifici - Ventilazione per gli edifici - Parte 3: Per gli edifici non residenziali - Requisiti prestazionali per i sistemi di ventilazione e di condizionamento degli ambienti (Moduli M5-1, M5-4)

UNI EN 16798 (tutte)	Ventilazione per gli edifici
UNI EN 17192:2019	Ventilazione per gli edifici - Condotte - Condotte non metalliche - Requisiti e metodi di prova
UNI EN 12237: 2004	Ventilazione degli edifici - Reti delle condotte - Resistenza e tenuta delle condotte circolari di lamiera metallica
UNI EN 1507: 2008	Ventilazione degli edifici - Condotte rettangolari di lamiera metallica - Requisiti di resistenza e di tenuta
UNI EN 13180: 2004	Ventilazione degli edifici - Rete delle condotte - Dimensioni e requisiti meccanici per le condotte flessibili
UNI EN 1751: 2014	Ventilazione degli edifici - Dispositivi per la distribuzione dell'aria - Prove aerodinamiche delle serrande e delle valvole
UNI EN 12599: 2012	Ventilazione per edifici - Procedure di prova e metodi di misurazione per la presa in consegna di impianti di ventilazione e di condizionamento dell'aria
UNI EN 13403: 2004	Ventilazione degli edifici - Condotti non metallici - Rete delle condotte realizzata con pannelli di materiale isolante
UNI 10349-1 :2016	Riscaldamento e raffrescamento degli edifici - Dati climatici - Parte 1: Medie mensili per la valutazione della prestazione termo-energetica dell'edificio e metodi per ripartire l'irradianza solare nella frazione diretta e diffusa e per calcolare l'irradianza solare su di una superficie inclinata
UNI/TR 10349-2:2016	Riscaldamento e raffrescamento degli edifici - Dati climatici - Parte 2: Dati di progetto
UNI 10349-3:2016	Riscaldamento e raffrescamento degli edifici - Dati climatici - Parte 3: Differenze di temperatura cumulate (gradi giorno) ed altri indici sintetici
UNI EN ISO 52120-1:2022	Prestazione energetica degli edifici - Contributo dell'automazione, del controllo e della gestione tecnica degli edifici - Parte 1: Quadro generale e procedure
UNI/TS 11651:2023	Procedura di asseverazione per i sistemi di automazione e regolazione degli edifici in conformità alla UNI EN ISO 52120-1
UNI 10351 :2021	Materiali da costruzione - Proprietà termoigrometriche - Procedura per la scelta dei valori di progetto
UNI 10355 :1994	Murature e solai. Valori della resistenza termica e metodo di calcolo
UNI 10375 :2011	Metodo di calcolo della temperatura interna estiva degli ambienti
UNI 10389-1:2019	Generatori di calore. Misurazione in opera del rendimento di combustione. Parte 1: Generatori di calore a combustibile liquido e/o gassoso
UNI 10412-1 :2006	Impianti di riscaldamento ad acqua calda - Requisiti di sicurezza - Parte 1: Requisiti specifici per impianti con generatori di calore alimentati da combustibili liquidi, gassosi, solidi polverizzati o con generatori di calore elettrici
UNI 10412-2 :2009 EC 1-2012	Impianti di riscaldamento ad acqua calda - Prescrizioni di sicurezza - Parte 2: Requisiti specifici per impianti con apparecchi per il riscaldamento di tipo domestico alimentati a combustibile solido con caldaia incorporata, con potenza del focolare complessiva non maggiore di 35 kW
UNI 10641 :2022	Canne fumarie collettive a tiraggio naturale per apparecchi a gas di tipo C con ventilatore nel circuito di combustione - Progettazione e verifica
UNI 10847 :2017	Pulizia di sistemi fumari per generatori e apparecchi alimentati con combustibili liquidi e solidi - Linee guida e procedure

UNI 11169 :2006	Impianti di climatizzazione degli edifici - Impianti aeraulici ai fini di benessere - Procedure per il collaudo
UNI 11135 :2004	Condizionatori d'aria, refrigeratori d'acqua e pompe di calore. Calcolo dell'efficienza stagionale.
UNI/TS 11300-1 :2014	Prestazioni energetiche degli edifici. Parte 1: Determinazione del fabbisogno di energia termica dell'edificio per la climatizzazione estiva ed invernale
UNI/TS 11300-2 :2019	Prestazioni energetiche degli edifici - Parte 2: Determinazione del fabbisogno di energia primaria e dei rendimenti per la climatizzazione invernale, per la produzione di acqua calda sanitaria, per la ventilazione e per l'illuminazione in edifici non residenziali
UNI/TS 11300-3 :2010	Prestazioni energetiche degli edifici - Parte 3: Determinazione del fabbisogno di energia primaria e dei rendimenti per la climatizzazione estiva
UNI/TS 11300-4 :2016	Prestazioni energetiche degli edifici - Parte 4: Utilizzo di energie rinnovabili e di altri metodi di generazione per la climatizzazione invernale e per la produzione di acqua calda sanitaria
UNI/TS 11300-5:2016	Prestazioni energetiche degli edifici - Parte 5: Calcolo dell'energia primaria e della quota di energia da fonti rinnovabili
UNI/TS 11300-6:2016	Prestazioni energetiche degli edifici - Parte 6: Determinazione del fabbisogno di energia per ascensori, scale mobili e marciapiedi mobili
UNI EN ISO 52016-1:2018	Prestazione energetica degli edifici - Fabbisogni energetici per riscaldamento e raffrescamento, temperature interne e carichi termici sensibili e latenti - Parte 1: Procedure di calcolo
UNI EN ISO 52016-3:2023	Prestazione energetica degli edifici - Fabbisogni energetici per riscaldamento e raffrescamento, temperature interne e carichi termici sensibili e latenti - Parte 1: Procedure di calcolo
UNI EN ISO 52017-1:2018	Prestazione energetica degli edifici - Carichi termici sensibili e latenti e temperature interne - Parte 1: Procedure generali di calcolo
UNI 11354 :2015	Dispositivi di intercettazione per reti di distribuzione e/o trasporto del gas - Valvole a farfalla
UNI 11466 :2012	Sistemi geotermici a pompa di calore - Requisiti per il dimensionamento e la progettazione
UNI/TS 11487 :2013	Sistemi geotermici a pompa di calore - Requisiti per l'installazione di impianti ad espansione diretta
UNI 11513 :2013	Verifica in esercizio della taratura delle valvole di sicurezza mediante martinetti
UNI 11528 :2022	Impianti a gas di portata termica maggiore di 35 kW - Progettazione, installazione e messa in servizio
UNI EN 12098-1 :2023	Prestazione energetica degli edifici - Controllo per impianti di riscaldamento - Parte 1: Dispositivi di controllo per gli impianti di riscaldamento ad acqua calda - Moduli M3-5, 6, 7, 8
UNI EN 12098-3 :2023	Prestazione energetica degli edifici - Controllo per impianti di riscaldamento - Parte 3: Dispositivi di controllo per gli impianti di riscaldamento elettrici - Moduli M3-5, 6, 7, 8
UNI EN 12114 :2001	Prestazione termica degli edifici. Permeabilità all'aria dei componenti e degli elementi per edilizia. Metodo di prova di laboratorio.

UNI EN 12170 :2002	Impianto di riscaldamento degli edifici. Procedure per la predisposizione della documentazione per la conduzione, la manutenzione e l'esercizio. Impianti di riscaldamento che richiedono personale qualificato per la conduzione.
UNI EN 12171 :2002	Impianto di riscaldamento degli edifici. Procedure per la predisposizione della documentazione per la conduzione, la manutenzione e l'esercizio. Impianti di riscaldamento che non richiedono personale qualificato per la conduzione.
UNI EN 12220 :2001	Ventilazione degli edifici. Reti delle condotte. Dimensioni delle flange circolari per la ventilazione generale.
UNI EN 12428 :2013	Porte industriali, commerciali e da garage. Trasmittanza termica. Requisiti per il calcolo.
UNI EN 12446 :2011	Camini. Componenti. Elementi esterni di calcestruzzo.
UNI EN 12599 :2012	Ventilazione per edifici - Procedure di prova e metodi di misurazione per la presa in consegna di impianti di ventilazione e di condizionamento dell'aria
UNI EN 12828 :2014	Impianti di riscaldamento degli edifici. Progettazione dei sistemi di riscaldamento ad acqua.
UNI EN 12831 (tutte):2018	Impianti di riscaldamento negli edifici - Metodo di calcolo del carico termico di progetto
UNI EN 12975-1 :2022	Collettori solari - Requisiti generali
UNI EN 13141-2:2010	Ventilazione degli edifici - Verifica della prestazione di componenti/ prodotti per la ventilazione degli alloggi - Parte 2: Bocchette per l'estrazione e l'immissione dell'aria
UNI EN 13141-3:2018	Ventilazione per gli edifici - Verifica delle prestazioni di componenti per gli edifici residenziali - Parte 3: Cappe aspiranti per uso residenziale senza ventilatore
UNI EN 13141-4 :2021	Ventilazione per gli edifici - Verifica delle prestazioni di componenti per gli edifici residenziali - Parte 4: Prestazioni aerodinamiche, elettriche e acustiche delle unità di ventilazione unidirezionali
UNI EN 13141-5:2021	Ventilazione per gli edifici - Verifica delle prestazioni di componenti per gli edifici residenziali - Parte 5: Cappe, cappe assistite e dispositivi terminali di uscita dal tetto
UNI EN 13141-6 :2015	Ventilazione degli edifici - Verifica della prestazione di componenti/ prodotti per la ventilazione degli alloggi - Parte 6: Kit per impianti di estrazione per abitazioni unifamiliari
UNI EN 13141-7 :2021	Ventilazione per gli edifici - Verifica delle prestazioni di componenti per gli edifici residenziali - Parte 7: Test delle prestazioni delle unità di ventilazione meccanica canalizzata e di estrazione (compreso il recupero di calore)
UNI EN 13141-8:2022	Ventilazione per gli edifici - Prove di prestazione di componenti/prodotti per la ventilazione residenziale - Parte 8: Prove di prestazione di unità di ventilazione meccanica non canalizzate e di scarico (compreso il recupero del calore)
UNI EN 13141-9 :2008	Ventilazione degli edifici - Valutazione delle prestazioni di componenti/prodotti per la ventilazione degli alloggi - Parte 9: Dispositivi di immissione dell'aria igroregolabili montati all'esterno
UNI EN 13141-10 :2008	Ventilazione degli edifici - Valutazione delle prestazioni di componenti/prodotti per la ventilazione degli alloggi - Parte 10: Dispositivi di estrazione dell'aria igroregolabili
UNI EN 13141-11 :2015	Ventilazione degli edifici - Verifica della prestazione di componenti/prodotti per la ventilazione degli alloggi - Parte 11: Unità di ventilazione di immissione

UNI EN ISO 13370 :2018	Prestazioni termiche degli edifici. Trasferimento del calore attraverso il terreno. Metodi di calcolo.
UNI EN 13384-1 :2019	Camini - Metodi di calcolo termo e fluido dinamico - Parte 1: Camini asserviti a un unico apparecchio a combustione
UNI EN 13384-2 :2019	Camini - Metodi di calcolo termo e fluido dinamico - Parte 2: Camini asserviti a più apparecchi a combustione
UNI EN 13384-3:2006	Camini - Metodi di calcolo termico e fluido dinamico - Parte 3: Metodi per l'elaborazione di diagrammi e tabelle per camini asserviti ad un solo apparecchio di riscaldamento
UNI EN 16798 (tutte)	Prestazione energetica degli edifici - Ventilazione per gli edifici
UNI EN 16798-3 :2018	Prestazione energetica degli edifici - Ventilazione per gli edifici - Parte 3: Per gli edifici non residenziali - Requisiti prestazionali per i sistemi di ventilazione e di condizionamento degli ambienti (Moduli M5-1, M5-4)
UNI EN 16798-7:2018	Prestazione energetica degli edifici - Ventilazione per gli edifici - Parte 7: Metodi di calcolo per la determinazione delle portate d'aria negli edifici compresa l'infiltrazione (Moduli M5-5)
UNI EN ISO 13786 2018	Prestazioni termica dei componenti per l'edilizia. Caratteristiche termiche dinamiche. Metodi di calcolo.
UNI EN ISO 13789 :2018	Prestazione termica degli edifici. Coefficiente di perdita del calore per trasmissione. Metodo di calcolo.
UNI EN ISO 9972:2015	Prestazione termica degli edifici. Determinazione della permeabilità all'aria degli edifici. Metodo di pressurizzazione mediante ventilatore.
UNI EN 13941-1 :2022	Tubazioni per teleriscaldamento - Progettazione ed installazione di tubazioni preisolate, singole o doppie, per reti di acqua calda interrate direttamente - Parte 1: Progettazione
UNI EN 13941-2:2022	Tubazioni per teleriscaldamento - Progettazione ed installazione di tubazioni preisolate, singole o doppie, per reti di acqua calda interrate direttamente - Parte 2: Installazione
UNI EN 14037-1 :2016	Strisce radianti a soffitto alimentate con acqua a temperatura minore di 120°C – Parte 1: Specifiche tecniche e requisiti.
UNI EN 14037-2 :2016	Strisce radianti a soffitto alimentate con acqua a temperatura minore di 120°C – Parte 2: Metodo di prova per determinare la potenza termica.
UNI EN 14037-3 :2016	Strisce radianti a soffitto alimentate con acqua a temperatura minore di 120°C – Parte 3: Determinazione della potenza nominale e valutazione della potenza termica radiante.
UNI EN 14037-4:2016	Pannelli radianti sospesi a soffitto per riscaldamento e raffrescamento alimentati con acqua a temperatura minore di 120°C - Parte 4: Pannelli radianti prefabbricati a soffitto - Metodo di prova per determinare la potenza frigorifera
UNI EN 14037-5:2016	Pannelli radianti sospesi a soffitto per riscaldamento e raffrescamento alimentati con acqua a temperatura minore di 120°C - Parte 5: Soffitti per riscaldamento aperti o chiusi - Metodo di prova per determinare la potenza termica
UNI EN ISO 15758:2016	Isolamento termico degli impianti di riscaldamento e raffrescamento degli edifici

UNI EN 14336 :2004	Impianti di riscaldamento negli edifici. Installazione e messa in servizio dei sistemi di riscaldamento ad acqua calda.
UNI EN 14419 :2009	Tubazioni per teleriscaldamento. Sistemi bloccati di tubazioni preisolate per reti di acqua calda interrate direttamente. Sistemi di sorveglianza.
UNI EN 14471 :2015	Camini. Sistemi di camini con condotti interni di plastica. Requisiti e metodo di prova.
UNI EN ISO 12631:2018	Prestazione termica delle facciate continue - Calcolo della trasmittanza termica
UNI EN ISO 14683 :2018	Ponti termici in edilizia. Coefficiente di trasmissione termica lineica. Metodi semplificati e valori di riferimento.
UNI EN 14825 :2022	Condizionatori d'aria, refrigeratori di liquidi e pompe di calore, con compressori azionati elettricamente, per il riscaldamento e il raffreddamento degli ambienti, il raffreddamento commerciale e di processo - Prove e valutazione a carico parziale e calcolo delle prestazioni stagionali
UNI EN 15116 :2008	Ventilazione degli edifici - Travi fredde - Prove e valutazione delle travi fredde attive
UNI EN ISO 52003-1:2018	Prestazione energetica degli edifici - Indicatori, requisiti, valutazioni e certificati - Parte 1: Aspetti generali e applicazione alla prestazione energetica complessiva
UNI EN 15316 (parti da 1 a 5): 2018	Metodo di calcolo per le richieste di energia e delle efficienze del sistema
UNI EN ISO 11855:2024 (tutte)	Progettazione dell'ambiente costruito - Progettazione, dimensionamento, installazione e controllo dei sistemi di riscaldamento e raffreddamento radianti integrati
UNI EN 15450 :2008	Impianti di riscaldamento negli edifici - Progettazione degli impianti di riscaldamento a pompa di calore
UNI EN 15780 :2011	Ventilazione degli edifici - Condotti - Pulizia dei sistemi di ventilazione
UNI EN ISO 15927-1 :2004	Prestazione termo igrometrica degli edifici. Calcolo e presentazione dei dati climatici. Medie mensili dei singoli elementi meteorologici.
UNI EN ISO 15927-2 :2009	Prestazione termoigrometrica degli edifici - Calcolo e presentazione dei dati climatici - Parte 2: Dati orari per il carico di raffrescamento di progetto
UNI EN ISO 15927-3 :2009	Prestazione termoigrometrica degli edifici - Calcolo e presentazione dei dati climatici - Parte 3: Calcolo di un indice di pioggia battente per superfici verticali a partire dai dati orari di vento e di pioggia
UNI EN ISO 15927-4 :2005	Prestazione termo igrometrica degli edifici. Calcolo e presentazione dei dati climatici. Parte 4: Dati orari per la valutazione del fabbisogno annuale di energia per il riscaldamento e il raffrescamento.
UNI EN ISO 15927-5 :2012	Prestazione termoigrometrica degli edifici - Calcolo e presentazione dei dati climatici - Parte 5: Dati per il carico termico di progetto per il riscaldamento degli ambienti
UNI EN ISO 16000-32 :2015	Aria in ambienti confinati - Parte 32: Indagine per verificare la presenza di inquinanti negli edifici
UNI EN 16430-1 :2015	Radiatori ventilati, convettori e convettori a pavimento - Parte 1: Specifiche tecniche e requisiti

UNI EN 16430-2 :2015	Radiatori ventilati, convettori e convettori a pavimento - Parte 2: Metodi di prova e valutazione della potenza termica
UNI EN 16430-3 :2015	Radiatori ventilati, convettori e convettori a pavimento - Parte 3: Metodi di prova e valutazione della potenza termica in raffrescamento
UNI EN 16497-1 :2015	Camini - Sistemi camino in calcestruzzo - Parte 1: Sistemi a flusso non bilanciato
UNI EN ISO 23553-1 :2022	Dispositivi di sicurezza e controllo per apparecchi e bruciatori ad olio combustibile - Requisiti particolari - Parte 1: Valvole automatiche e semiautomatiche
UNI EN ISO 23993 :2011	Isolanti termici per gli impianti degli edifici e per le installazioni industriali - Determinazione della conduttività termica di progetto
UNI CIG (tutte)	Norme per la sicurezza dell'impiego del gas combustibile.

UNI reference standards for plumbing and sanitary systems

UNI EN 476:2022	Requisiti generali per componenti utilizzati nelle connessioni di scarico e nei collettori di fognatura per sistemi di scarico a gravità
UNI EN 806-1 :2008	Specifiche relative agli impianti all'interno di edifici per il convogliamento di acque destinate al consumo umano - Parte 1: Generalità
UNI EN 806-2 :2008	Specifiche relative agli impianti all'interno di edifici per il convogliamento di acque destinate al consumo umano - Parte 2: Progettazione
UNI EN 806-3 :2008	Specifiche relative agli impianti all'interno di edifici per il convogliamento di acque destinate al consumo umano - Parte 3: Dimensionamento delle tubazioni - Metodo semplificato
UNI 8065 :2019 + EC 1-2019	Trattamento dell'acqua negli impianti per la climatizzazione invernale ed estiva, per la produzione di acqua calda sanitaria e negli impianti solari termici
UNI 9182 :2014	Impianti di alimentazione e distribuzione di acqua fredda e calda. Criteri di progettazione, collaudo e gestione
UNI EN ISO 9806 :2018	Energia solare - Collettori solari termici - Metodi di prova
UNI EN ISO 9488 :2022	Energia solare. Vocabolario.
UNI 10637 :2024	Piscine ad uso pubblico - Requisiti degli impianti di circolazione, filtrazione, disinfezione e trattamenti chimico-fisici dell'acqua di piscina
UNI/TS 11445 :2012 EC 1-2012	Impianti per la raccolta e utilizzo dell'acqua piovana per usi diversi dal consumo umano - Progettazione, installazione e manutenzione
UNI EN 12050-1 :2015	Impianti di sollevamento delle acque reflue per edifici e cantieri - Parte 1: Impianti di sollevamento per acque reflue contenenti materiale fecale
UNI EN 12050-2 :2015	Impianti di sollevamento delle acque reflue per edifici e cantieri - Parte 2: Impianti di sollevamento per acque reflue prive di materiale fecale
UNI EN 12050-3 :2015	Impianti di sollevamento delle acque reflue per edifici e cantieri - Parte 3: Impianti di sollevamento per acque reflue per applicazioni limitate
UNI EN 12050-4 :2015	Impianti di sollevamento delle acque reflue per edifici e cantieri - Parte 4: Valvole di non-ritorno per acque reflue prive di materiale fecale e per acque reflue contenenti materiale fecale
UNI EN 12056-(tutte) :2001	Sistemi di scarico funzionanti a gravità all'interno degli edifici

UNI EN 12566-3 :2013	Piccoli sistemi di trattamento delle acque reflue fino a 50 PT - Parte 3: Impianti di trattamento preassemblati e/o assemblati in sito delle acque reflue domestiche
UNI EN 12975:2022	Collettori solari. Requisiti generali.
UNI EN 14654-3 :2021	Gestione e controllo delle attività operative negli impianti di raccolta e smaltimento di acque reflue all'esterno di edifici - Parte 3: Pulizia negli impianti di raccolta e smaltimento di acque reflue
UNI CEN/TR 16355 :2012	Raccomandazioni per la prevenzione della crescita della legionella negli impianti all'interno degli edifici che convogliano acqua per il consumo umano

UNI reference standards for fire protection systems

UNI EN 694 :2014	Tubazioni antincendio - Tubazioni semirigide per sistemi fissi
UNI EN 1366-1 :2020	Prove di resistenza al fuoco per impianti di fornitura servizi - Parte 1: Condotte di ventilazione
UNI EN 1366-2 :2015	Prove di resistenza al fuoco per impianti di fornitura servizi - Parte 2: Serrande tagliafuoco
UNI EN 1366-3 :2022	Prove di resistenza al fuoco per impianti di fornitura servizi - Parte 3: Sigillanti per attraversamenti
UNI EN 1366-5:2021	Prove di resistenza al fuoco per impianti di fornitura servizi - Parte 5: Canalizzazioni di servizio e cavedi
UNI EN 1366-12 :2014	Prove di resistenza al fuoco per impianti di fornitura servizi - Parte 12: Barriere tagliafuoco non meccaniche per le condotte di ventilazione
UNI EN 1366-13:2019	Prove di resistenza al fuoco per impianti di fornitura servizi - Parte 13: Camini
UNI EN 1568-(tutte) :2018 EC 1-2010	Mezzi di estinzione incendi - Liquidi schiumogeni concentrati
UNI EN 1866-2 :2014	Estintori d'incendio carrellati - Parte 2: Requisiti per la fabbricazione, resistenza a pressione e prove meccaniche per estintori, con una pressione massima ammissibile uguale o minore di 30 bar, che sono conformi ai requisiti espressi nella EN 1866-1
UNI EN 1866-3 :2013	Estintori d'incendio carrellati - Parte 3: Requisiti per l'assemblaggio, la fabbricazione e la resistenza a pressione di estintori a CO2 conformi ai requisiti della EN 1866-1
UNI 9487 :2006	Apparecchiature per estinzione incendi - Tubazioni flessibili antincendio di DN 70 per pressioni di esercizio fino a 1,2 MPa
UNI 9494-1:2017	Sistemi per il controllo di fumo e calore - Parte 1: Progettazione e installazione dei Sistemi di Evacuazione Naturale di Fumo e Calore (SENFC)
UNI 9494-2:2017	Sistemi per il controllo di fumo e calore - Parte 2: Progettazione e installazione dei Sistemi di Evacuazione Forzata di Fumo e Calore (SEFFC)
UNI 9494-3:2014	Sistemi per il controllo di fumo e calore - Parte 3: Controllo iniziale e manutenzione dei sistemi di evacuazione di fumo e calore
UNI 9994-1:2013	Apparecchiature per estinzione incendi - Estintori di incendio - Parte 1: Controllo iniziale e manutenzione
UNI 10779 :2021	Impianti di estinzione incendi - Reti di idranti - Progettazione, installazione ed esercizio

UNI 11292 :2019	Locali destinati ad ospitare gruppi di pompaggio per impianti antincendio - Caratteristiche costruttive e funzionali
UNI 11443 :2012 EC 1-2014	Sistemi fissi antincendio - Sistemi di tubazioni - Valvole di intercettazione antincendio
UNI/TS 11559 :2014	Impianti di estinzione incendi - Reti di idranti a secco - Progettazione, installazione ed esercizio
UNI EN 12094-(tutte)	Sistemi fissi di lotta contro l'incendio - Componenti di impianti di estinzione a gas -
UNI EN 12259-1 :2007	Installazioni fisse antincendio - Componenti per sistemi a sprinkler e a spruzzo d'acqua - Parte 1: Sprinkler
UNI EN 12845 :2020	Installazioni fisse antincendio - Sistemi automatici a sprinkler. Progettazione, installazione e manutenzione
UNI/TR 11438:2016	Installazioni fisse antincendio - Gruppi di pompaggio - Istruzioni complementari per l'applicazione della UNI EN 12845 (sprinkler)
UNI EN 14339 :2006	Idranti antincendio sottosuolo
UNI EN 14384 :2006 EC 2-2011	Idranti antincendio a colonna soprasuolo
UNI EN 14540 :2014	Tubazioni antincendio - Tubazioni appiattibili impermeabili per impianti fissi
UNI CEN/TS 14816 :2009	Installazioni fisse antincendio - Sistemi spray ad acqua - Progettazione, installazione e manutenzione
UNI EN 15004-(tutte)	Installazioni fisse antincendio - Sistemi a estinguenti gassosi
UNI EN 15423 :2008	Ventilazione degli edifici - Misure antincendio per i sistemi di distribuzione dell'aria negli edifici
UNI EN 15276-1:2019	Sistemi fissi di lotta contro l'incendio - Sistemi di estinzione ad aerosol condensato - Parte 1: Requisiti e metodi di prova per i componenti
UNI EN 15276-2:2019	Sistemi fissi di lotta contro l'incendio - Sistemi di estinzione ad aerosol condensato - Parte 2: Progettazione, installazione e manutenzione

<u>UNI reference standards for the preparation of the maintenance plan</u>

UNI 10685 :2007	Manutenzione - Criteri per la formulazione di un contratto di manutenzione basato sui risultati (global service di manutenzione)
UNI 10874 :2000	Manutenzione dei patrimoni immobiliari - Criteri di stesura dei manuali d'uso e di manutenzione.
UNI 11136 :2004	Global service per la manutenzione dei patrimoni immobiliari - Linee guida
UNI 11257 :2007	Manutenzione dei patrimoni immobiliari - Criteri per la stesura del piano e del programma di manutenzione dei beni edilizi - Linee guida
UNI EN 15331 :2011	Criteri di progettazione, gestione e controllo dei servizi di manutenzione degli immobili

Every other prescription, regulation, and recommendation issued by authorities and applicable to the systems in this project. Compliance with the aforementioned standards is intended in the most restrictive sense, meaning that not only the installation of the system must comply with these standards, but also every single component of the system itself.

Other regulations, having the force of law, relating to individual system components, even if not explicitly mentioned, must be strictly applied.
Regarding electrical components, all equipment as a whole, as well as individual units and all components of the systems, must be of proven quality and bear the CEI marking and/or the I.M.Q. certification, or an equivalent quality mark if of foreign production.
Compliance with the standards and requirements is to be understood as applying to all components. It shall be verified during testing, either directly or through test certificates provided by the Contractor, accompanied by an explicit guarantee that the supplied materials are identical to the prototypes subjected to testing.
The Contractor must comply with all provisions that are in force or that may come into force before and after the date of the tender specified in this document.
The Installation Contractor must promptly inform the Client of any updates or modifications to the project or systems resulting from the issuance of new standards or amendments to existing ones.
Upon approval by the Client, the Installation Contractor is obligated to make the necessary adjustments. In such cases, any additional costs will be recognized only if the publication date of the standard is later than the date of the tender submission.
The Client and the Construction Supervisor are expressly exempt from any civil or criminal liability.
Compliance with the standards and requirements is to be understood as applying to all components. It shall be verified during the execution of the works or during testing, either directly or through test certificates provided by the Contractor, accompanied by an explicit written guarantee that the supplied materials are identical to the prototypes subjected to testing.
Furthermore, all provisions issued by the local Fire Brigade Command regarding fire prevention, as well as all other applicable technical standards (UNI, UNI-CIG, UNI-CTI, etc.) in effect at the time of the system's construction, shall be observed, even if not explicitly mentioned in the text above.

5. CLASSIFICATION OF ENVIRONMENTS

The project ensures compliance with the specific fire prevention regulations applicable. For classification and requirements regarding Fire Brigade (VVF) provisions, refer to the fire prevention documentation.

6. TECHNICAL CHARACTERISTICS OF MATERIALS AND COMPONENTS

It is specified that the following technical specifications shall be considered supplementary to those prescribed in the bill of quantities. In the event of technical discrepancies, the Contractor must adhere to the most stringent provisions, prioritizing the safety of people and property.

6.1. Testing and sampling of materials, equipment, and system components

The Contractor shall perform tests on materials, equipment, or system components when requested by the Client or the work supervisor (D.L.), following procedures agreed upon with the latter. The results of these tests must be communicated in writing to obtain approval.
The aforementioned tests will be particularly required in cases involving equipment and materials with insufficient documentation from the manufacturer or supplier, or for solutions and applications of equipment, materials, and system components where functional verification is deemed necessary before installation approval.
Tests shall be conducted either on-site or at another location, as agreed upon.
Upon request by the work supervisor (D.L.), and according to procedures agreed upon with the same, the contractor must provide samples of materials, equipment, and/or execution and construction methods for the system components.
Samples must be clearly listed and marked to ensure approval is granted without ambiguity.
If the samples submitted to the work supervisor (D.L.) are not approved, the contractor must submit alternatives until approval is obtained.
Before proceeding with the procurement of all materials, equipment, and components described in the bill of quantities or otherwise intended for installation in the system, the Contractor must submit for approval by the work supervisor (D.L.) the technical, performance, and dimensional characteristics of the components, following the procedure outlined below:

- Material Sampling: Submission of material samples for evaluation.
- Attachment of Technical Sheets: Inclusion of technical data sheets for the material or component, clearly highlighting the technical characteristics.
- Submission to Project Supervisor: Transmission of the document with attached technical sheets to the Project Supervisor (D.L.).
- Adjustments and Resubmissions: Implementation of any modifications, additions, or replacements required until final approval is obtained from the Project Supervisor.

Materials that are not approved shall, under no circumstances, be deemed suitable for use.
The approval of materials does not constitute acceptance and shall in no way prejudice the Client's rights during the final inspection and testing phase.
Regarding the selection of finishes, it is specified that the Client reserves the right to request the most appropriate coloration without incurring any additional costs.

6.2. Quality and origin of materials

In agreement with the Client, it is specified that offering and/or installing products other than those specified in this document or in the brand list is strictly prohibited.
The Contractor is required to specify the manufacturer for all materials not explicitly named in this document and must agree on these materials with the Client prior to their installation.

All materials must comply with environmental standards in accordance with UNI EN ISO 14001.

6.3. Protection and cleaning of systems

During the construction phase, all equipment must be protected with plastic sheeting securely fastened to the equipment frames to prevent the penetration of dust during work activities.
The ends and openings of ducts must be kept closed with appropriate covers (caps or end plates) made of sheet metal. Special care must be taken to preserve any internal insulating linings.
Before testing begins, a site inspection will be conducted with the Project Supervisor (D.L.) to assess the condition of the equipment and to prescribe any corrective actions necessary to ensure that testing is carried out under optimal conditions.

6.4. Off-Site manufacturing

The general contractor may propose to review updated positions of equipment, materials of construction, layouts, and size of equipment rooms such as packaged pump rooms, to suit offsite fabrication of modular rooms. Any changes proposed for off-site manufacturing shall meet all technical specifications described within the employers' requirements.

6.5. Testing

The description of equipment and materials includes a list of the main testing procedures that the Installing Contractor must carry out.
The Contractor must compile the testing results into specific tables. These tables must clearly indicate: the codes of the tested equipment, the date of execution, the individuals present, the measured parameters, the recorded values, the design or limit values, and the instrument used. The tables must be signed by the operator who conducted the tests and countersigned by the Construction Supervision.

6.6. Labeling

All equipment present in the field must be labeled. All labels must be made of traffolyte, with texts engraved using a milling cutter or laser.

All uninsulated pipes must be painted with colors compliant with standards and approved by the Construction Supervision (D.L.).

All pipes must have colored identification bands in accordance with UNI 5634 standards and include indications of the direction of fluid flow.

The identification markings and flow direction indications must always be placed at collector outlets, equipment connections, at the base of shafts, at riser branches, and at the main floor branches. In cases where circuits transport the same fluid but with different design temperatures (e.g., hot water for air handling unit coils, hot water for radiators, hot water for post-heating coils, hot/chilled water for fan coils, chilled water), identification tags for the various circuits must be affixed.

The use of green-red for hot water or green-blue for chilled water must be avoided, as such combinations, according to the cited standard, designate fire-fighting water and potable or washing

water.
Circuits departing from collectors must be identified with indicator tags, made of galvanized steel or plastic material with a transparent plexiglass protective cover.

For the label colors, reference must be made to UNI 5634:1997 (Table provided below), with the following colors:

Table 4.2-1 Designation of Colors

Fluid Service	Background Color	Letter Color	Color and Letter Sample
Fire quenching fluids	Safety red	White	Letters
Toxic and corrosive fluids	Safety orange	Black	Letters
Flammable and oxidizing fluids	Safety yellow	Black	Letters
Combustible fluids	Safety brown	White	Letters
Potable, cooling, boiler feed, and other water	Safety green	White	Letters
Compressed air	Safety blue	White	Letters
To be defined by the user	Safety purple	White	Letters
To be defined by the user	Safety white	Black	Letters
To be defined by the user	Safety gray	White	Letters
To be defined by the user	Safety black	White	Letters

Fire protection= Red
Toxic and corrosive fluids (secondary loop CDU-Rack) = Orange
Combustible fluid (Fuel for generators and diesel pumps) = Brown
Potable water, Cooling water, Boiler Feed, and other water = Green
Compressed air (sprinkler PA / Dry) = Blue
DX systems = Black
Smoke management systems: Purple
Non potable water systems = Green (with indication of NON POTABLE WATER – DO NOT DRINK)
Ventilation (AHU/Fresh Air/Extraction) = Grey
Drainage = Black

The contrast between the label background and the lettering must comply with the specifications defined by the UNI 5634-1997 standard.

All labels must be made of traffolyte, with texts engraved using a milling cutter or laser, following the dimensions outlined above.

For font size, label orientation relative to the flow, and label positioning concerning obstacles such as walls or partitions, refer to the ASME/ANSI A13 standard.

The following components of the mechanical systems must be labeled:

Critical systems = Manual and motorized components
Non-critical Systems = Motorized components

Cooling Series
Critical systems = Manual and motorized components
Non-critical systems = Motorized/electrical components (e.g., the VRF system for offices must have labels on indoor units, distributors, and environmental control panels).

Ventilation Series
Critical systems = Manual and motorized components
Non-critical systems = Motorized/electrical components

Water Services
Critical systems = Manual and motorized components
Non-critical systems = Motorized/electrical components

Drainage services
Non-critical systems = Motorized/electrical components (lifting pumps)

Fire services
Critical systems = Manual and motorized components

Fuel Services
Critical systems = Manual and motorized components

Non potable water
Non-critical systems = Motorized/electrical components (lifting pumps)

BMS Services
Critical systems = Manual and motorized components

The type of label will be as follows:

- For diameters up to DN50, a band will be applied directly to the pipe near the component.
- For diameters greater than DN50, the label will be applied to the aluminum cladding, if necessary, secured with metal straps around the insulation.
- For dampers and channel accessories, the label will be applied near the respective component.
- For machinery/equipment, the labels will be applied directly to the component in a clearly visible position.
-

6.7. Fans

This specification defines the unit subject to supply, including the documentation and the supply conditions in terms of testing and delivery.

6.7.1. Reference standards

The Supplier must comply with all regulations in force within the national territory, specifically:

- Direttiva macchine 2006/42/UE
- Direttiva LVD 2014/35/UE
- Direttiva EMC 2014/30/UE
- Direttiva PED 2014/68/UE
- UNI EN 12100
- UNI EN 12101
- UNI EN 779
- UNI EN 9177
- UNI EN 10152
- ISO 1940-1
- DIN 24163
- BS 848-1
- AMCA 210
- D.P.R. 459/96
- D.P.R. 547/55
- DLgs. 81/08
- Normativa ErP Nr.:1253/2014

Compliance with this specification does not exempt the Supplier from the responsibility of adopting all measures and elements necessary to ensure the correct functioning of the unit.

6.7.2. Documentation to be provided for approval

Documents to be provided for approval:

- Dimensions of the equipment, clearance spaces, static and dynamic loads;
- Declaration of sound power levels in dB(A) and in dB across octave bands for the fans;
- Declaration of sound pressure levels, measured one meter from the unit in free field, in dB(A) and in dB across octave bands;
- Workshop construction drawing of the unit;
- Construction details for installation;
- Details of ductwork and electrical connections (dimensioned and positioned drawings of connections and passage holes);
- Details of monitoring points for the equipment and the communication protocol for interfacing with the building management system.

6.7.3. Testing and commissioning

The systems in question must undergo a series of tests over time to verify full compliance with technical specifications and their actual functionality.
The test results must be documented on forms approved by the Project Management. These forms must include at least the following information: the date of execution, the personnel present, the measured quantities, the recorded values, the design or limit values, and the instruments used. The forms must be signed by the operator who performed the tests and countersigned by the Project Management.
The tester will verify functional compliance with the project and, at their discretion, may repeat the most significant tests in the presence of the Contractor.
Reference should be made to the contents of paragraph 3, as well as any additional details specified in this section.
The above will be carried out in addition to the Commissioning process as described in the technical report.

6.7.4. Construction characteristics

Refer to *A05 ES E CM 01- Annex 05 – Fan.*

6.7.5. Data sheets and project based specifications

Refer to *MIL05B-BWE-SW-XX-SH-M-50702 Mechanical Equipment Schedule.*

6.8. Air terminal units

This specification defines the unit subject to supply, including the documentation and supply conditions in terms of testing and delivery.

6.8.1. Reference standards

- Product standards

6.8.2. Documentation to be provided for approval

- Construction drawings, scaled as required by the Project Supervision, showing the exact location of the terminals and all their accessory components (including supports);
- Installation specifications provided by the manufacturer;
- Installation details;
- Operating and calibration diagrams (flow rates, velocities, pressure losses, sound power levels, or sound pressure levels).

6.8.3. Testing and commissioning

The systems in question must undergo a series of tests over time to verify full compliance with technical specifications and their actual functionality.
The test results must be documented on forms approved by the Project Management. These forms must include at least the following information: the date of execution, the personnel present, the measured quantities, the recorded values, the design or limit values, and the instruments used. The forms must be signed by the operator who performed the tests and countersigned by the Project Management.
The tester will verify functional compliance with the project and, at their discretion, may repeat the most significant tests in the presence of the Contractor.
Reference should be made to the contents of paragraph 3, as well as any additional details specified in this section.
The above will be carried out in addition to the Commissioning process as described in the technical report.
The types of tests may include:

- visual and dimensional inspections;
- checks on assembly execution, materials used, and qualitative verifications;
- noise testing;
- verification of declared performance;
- Testing.

6.8.3.1. Acceptance tests

Acceptance tests must be performed on all elements of a supply, under the conditions covered by the warranty.

Qualitative verifications

These verifications concern both the supply as a whole and its individual components. They will be conducted partly at the manufacturing facilities and partly during assembly, at the sole discretion of the Client.

The Client's inspectors will have the right to monitor the progress of the supply phases and verify its compliance with the requirements and specifications referenced in the order.

Airtightness testing of ductwork connections must be carried out as specified in the relevant ductwork specifications.

These verifications must confirm the absence of material or assembly defects.

Functional testing

Functional testing is generally performed by the Client's Technical Service, with a tester designated by the Client and with a maximum notice of 10 days. Once installation, calibration, and adjustments are complete, the following verifications will be performed:

- airflow rate (supplied or extracted);
- emitted noise levels;
- velocity at the end of the throw (for supply units only).
- All necessary testing instruments and related assistance personnel will be provided at the Contractor's expense.

6.8.4. Construction characteristics

Refer to *A07 ES E CM 01- Annex 07 – Grilles, Diffusers, and Louvres.*

6.8.5. Data sheets and project based specifications

Refer to *MIL05B-BWE-SW-XX-SH-M-50702 Mechanical Equipment Schedule.*

6.9. Pipework, fittings and ancillaries

Unless otherwise specified, all specified pipe dimensions are nominal internal dimensions.
The pipes must be new and supplied in lengths or coils directly from the manufacturer, with a length not less than 6 meters, except where shorter or flanged lengths are specifically required between fittings.
The pipes must be supplied with the manufacturer's standard finish and protection, depending on the material. Upon delivery, each pipe section must have at least one colored identification band or identification marking. The pipes must be of Italian manufacture and must be identified with the appropriate marking "Made in Italy."

The piping must be free from surface or general corrosion, harmful films, and free from scaling, pitting, excessive weather damage, or other types of damage. The openings must be clean and unobstructed. Any damaged pipes must be removed from the site and replaced. Pipes must be stored raised off the ground on flat, level surfaces or on packaging. The storage area must be free of protrusions that could damage the pipes. Pipes stored outdoors must be adequately covered and protected from the elements.

Materials must be stored in dry conditions to prevent damage or corrosion. The Project Management will reject improperly stored materials.

6.9.1. Reference standards

Reference standards for piping:

- D.M. 12 dicembre 1985 "Norme tecniche relative alle tubazioni"
- Decreto Ministeriale 12 aprile 1996 “Approvazione regola tecnica di prevenzione incendi per la progettazione, la costruzione e l’esercizio degli impianti termici alimentati da combustibili gassosi.”
- Decreto Ministeriale 24 novembre 1984 “Norme di sicurezza per il trasporto, la distribuzione, l’accumulo e la utilizzazione del gas naturale con densità non superiore a 0,6.”
- Norme UNI relative alle tubazioni e raccorderia.
- Norme UNI-CIG per la sicurezza nell'impiego del gas combustibile.
- Norma UNI 9182 "Impianti di alimentazione e distribuzione di acqua fredda e calda. Criteri di progettazione, collaudo e gestione."
- D.M. 24 novembre 1984 "Norme di sicurezza antincendio per il trasporto, la distribuzione, l'accumulo e l'utilizzazione del gas naturale con densità non superiore a 0,8."
- Norme UNI EN 12845 “Installazioni fisse antincendio - Sistemi automatici a sprinkler. Progettazione, installazione e manutenzione”
- Norma UNI 10779- “Apparecchiature per estinzione incendi - Alimentazioni idriche per impianti automatici antincendio.”

- Norma UNI 5745 "Rivestimento a caldo di zinco dei tubi di acciaio. Prescrizioni e prove"
- Norma UNI EN 10204 "Prodotti metallici. Tipi di documenti di controllo"

Reference standards for valves:

- Norme ISPESL
- Norma UNI-ISO 5209 - "Valvolame industriale di uso corrente. Marcatura"
- Norma UNI 6884 - "Valvole di intercettazione e regolazione di fluidi. Condizioni tecniche di fornitura e collaudo"
- Norma UNI 7125 e UNI FA 109 - "Saracinesche flangiate per condotte d'acqua. Condizioni tecniche di fornitura"
- Norma UNI 8858 - "Valvole a sfera di leghe di rame per impieghi in impianti di riscaldamento. Prescrizioni e prove"
- Norma UNI 9021 - "Valvole a saracinesca di leghe di rame per impianti di riscaldamento. Requisiti e prove"
- Norma UNI 9157 - "Impianti idrici. Disconnettori a tre vie. Caratteristiche e prove"
- Norma UNI 9335 - "Valvole di sicurezza per apparecchi a pressione - Generalità, requisiti e prove"

Reference standards for expansion vessels:

- D.M. 01.12.1975 e norme INAIL

6.9.2. Documents to be provided for approval

Documents Required for Piping Approval:

- Detailed construction drawings, scaled as specified by the Site Supervision team, accurately reflecting the precise layout of the networks and all associated components (valves, expansion joints, fixed points, sliding points, drains, vents, instrumentation, supports, etc.).
- Verification calculations for expansion compensation.
- Detailed designs for clamps, insulation, and supports.
- Certificates of compliance for the piping.

Documents Required for Valve Approval:

- Detailed construction drawings of the networks, clearly indicating the position of various components.
- Safety valve calculations and the corresponding ISPESL (Italian Institute for Occupational Safety and Prevention) approval certificates.

Documents Required for Approval for Expansion Vessels:

- Installation details.
- Technical and illustrative documentation provided by the manufacturer.

- Verification calculations for the water content of the system and operating pressures.

6.9.3. Testing and commissioning

The systems in question must be subjected to a series of tests over time to verify full compliance with the technical specifications, as well as their actual functionality.
The results of the tests must be recorded on forms approved by the Project Supervision Team. The forms must include at least: the date of the test, the individuals present, the measured parameters, the recorded values, the design or limit values, and the instruments used. The forms must be signed by the operator conducting the tests and countersigned by the Project Supervision Team.
The inspector will verify functional compliance with the project and, at their discretion, may repeat the most significant tests in collaboration with the Contractor.
Refer to the provisions outlined in paragraph 3, along with any additions included in this paragraph.
The above shall be performed in addition to the Commissioning process as described in the technical report.

The types of tests may include:
- Visual and dimensional inspection;
- Verification of assembly execution and materials used, and qualitative checks;
- Noise testing;
- Verification of declared performance;
- System testing.

Water Piping
The piping must undergo hydraulic pressure testing upon completion of installation and before the completion of masonry work and the application of insulating coatings.

Except in special cases where specific requirements apply, for operating pressures below 10 bar, the test pressure must be 1.5 times the operating pressure, with a minimum of 6 bar for open circuits.

For higher pressures, the hydraulic test must be conducted at a pressure 5 bar above the operating pressure.

The system must be maintained under pressure for 4 hours; during this period, an inspection must be carried out to identify any potential leaks.

The test is considered successful if the control pressure gauge does not detect pressure drops exceeding 0.2 bar throughout the specified time.

After the hydraulic test and before commissioning the systems, the piping must be thoroughly cleaned.
The cleaning process must be carried out by draining water through the appropriate outlets until the discharged water runs clear.

The final cleanliness inspection is to be conducted in the presence of the Project Supervision Team. The system must be filled immediately after the cleaning operations are completed.

For open-circuit piping, refer to UNI standards.
Hot water distribution piping, whether in closed circuits or for centralized production and consumption, must undergo a hot hydraulic test.

For closed-circuit piping, the test must be conducted at the maximum design temperature. For hot water distribution piping for consumption, the test must be performed after the commissioning of the hot water preparation system, at operating pressure, for no less than two consecutive hours, with an initial temperature at least 10°C higher than the maximum operating temperature achievable during use.

The purpose of the test is to verify the effects of thermal expansion on the piping.

Visual inspection of accessible parts and indirect evaluation of non-accessible parts must confirm the free movement of the piping, particularly at points where it passes through structural walls, without causing damage to the structures or any unforeseen deformation of the piping beyond calculated tolerances.

Gas Fuel Piping
Gas piping must be subjected to pressure testing as specified in D.M. 24 November 1984, D.M. 12 April 1996, or UNI standard 7129, depending on the specific circumstances.

6.9.3.1. Circuit calibration

After the completion of installations and pressure tests, the adjustment and calibration of water flow rates for each device must be performed.

The contractor must systematically compile the following data into tables:

For each calibration valve:
- Identification code (as indicated in the as-built drawings);
- Nominal diameter;
- Design flow rate;
- Position of the calibration element (number of handwheel turns);
- Pressure drop;
- Measured actual flow rate.

For each circulation pump:
- Identification code;
- Design conditions (flow rate, head, absorbed power);

- Measured head;
- Measured absorbed electrical power;
- Measured flow rate (from calibration valve or equipment performance curves);
- Operating point identified on the characteristic curve.

For each pressure-reducing valve:
- Identification code (as indicated in the as-built drawings);
- Nominal diameter;
- Design flow rate (if applicable);
- Position of the calibration element;
- Upstream nominal and measured pressure;
- Downstream nominal and measured pressure;
- Calibration pressure of the downstream safety valve (if applicable).

For each safety valve:
- Identification code (as indicated in the as-built drawings);
- Nominal diameter;
- Nominal opening pressure;
- Measured opening pressure.

In the data collection tables for circuit calibration operations, the following must be clearly included: the date of execution, the personnel present, the circuit involved, the parameters measured, the values recorded, and the instrument used.

The tables must be signed by the operator who performed the tests and countersigned by the Site Supervision.

6.9.3.2. Flushing

The purpose of this procedure is to ensure that the water pipes of hydronic circuits are properly cleaned, removing unwanted contaminants from the installation (e.g., mill scale or metal shavings) and mitigating long-term issues such as corrosion and microbial growth.
Bypasses for flushing must be installed at each terminal unit to isolate the equipment.
At the conclusion of flushing operations, analyses must be conducted to verify the quality of the system water.

The following parameters must be achieved:

pH	---	7,5 - 9,0
Alkalinity (HCO_3^-)	ppm	70 - 200
SO_4^{2-}	ppm	< 100
HCO_3^- / SO_4^{2-}	---	> 1,5
(Ca+Mg)/(HCO_3^-)	---	> 0,5
Cl^-	ppm	< 100
PO_4^{3-}	ppm	< 2,0
NH_3	ppm	< 0,5
Nitrate(NO_3^-)	ppm	< 100
Free Chlorine (Cl_2)	ppm	< 1
Iron Fe^{3+}	ppm	< 1
Copper Cu	ppm	< 1
CO_2	ppm	< 10
H_2S	ppb	< 50
Oxygen content	ppm	< 0,1
Total Suspended solids	mg/l	< 1500
Electric conducibility	µS/cm	10 - 500
Total hardness	dH	4,0 - 8,5

In addition, it must be verified that:

- Pseudomonas: < 1,000 cfu / 100ml @ 30 °C
- Glycol percentage: As per design specifications

The following minimum flow velocities must be achieved within the pipes during flushing operations:

Before beginning any activity, a sample of the water used to fill the system will be taken to verify its initial characteristics.
It must also be verified that the bypasses at the terminal units are open, excluding these units from the process as they will have already been cleaned and flushed at the factory.

Fill the system from the water mains using the filling connection until the circuit is completely filled. Calculate the total water content of the system to predetermine the quantity of chemical conditioning to be introduced upon completion of the work.

Activate the pumps and ensure they are functioning correctly.

Circulate the water with the drain valves open for approximately 30 minutes to suspend any residual debris from construction, while monitoring the system pressures. Longer durations may be defined by the commissioning authority within the dedicated commissioning procedure.
Record the flow rate/velocity during flushing to confirm compliance with the prescribed velocities.

While keeping the filling connection open, open the drain valves one at a time, starting from the lowest level, to initiate the flushing procedure.
Flush each point until the discharged water runs clear.

Turn off the pumps, close the valves starting from the highest level, and remove the filter from the pumps. Note that the filters must be replaced at the end of the flushing operations.

Open the valves and restart the pump. Repeat the process until the filter is clean. On-site water parameters should be checked using portable kits.

If the soluble iron level is high, add a specific chemical product and allow it to circulate for 3 days. Then, empty the circuit and restart the flushing procedure. If the soluble iron level is acceptable, proceed to the next step.
Once a section of piping has been flushed, a minimum flow rate with a water velocity of 0.2 m/s must be maintained until completion.

Regularly check the dirt separator and clean it once daily or as needed.
The circuit will be refilled, reactivating the chemical conditioning systems. Once filled, the water will circulate for at least one hour to ensure efficient and complete mixing of the chemicals and uniform conditions throughout the circuit. Check the chemical dosage and adjust if necessary.

Verify the water parameters on-site using portable kits, and repeat the above steps if the values are not within acceptable limits.
Two samples of one liter each will be taken in dedicated glass containers: one from the lowest point of the circuit and one from the highest point. These samples will be delivered, maintaining a constant temperature, to a laboratory for analysis of their chemical and physical characteristics.

If the laboratory results meet the specified values, the circuit flushing and conditioning work will be considered complete. If the results do not meet the specified values, appropriate corrective actions will be taken, and the flushing process will be repeated until acceptable values are achieved.

Depending on the results, the necessity of reverse flushing will be evaluated.
After completing the flushing process, bypasses at the terminal units will be closed to fully load the system.

Upon completion of the flushing process, glycol will be added as per design specifications. A sample will then be taken and sent to the laboratory for analysis.

Following the flushing, water quality will be checked one week prior to system handover to ensure it remains within the agreed limits.

6.9.3.3. Disinfection

Disinfection must be carried out in accordance with the guidelines of UNI 9182 "Water supply and distribution systems," using gaseous chlorine, a mixture of water and gaseous chlorine, or a sodium hypochlorite solution.

Finally, a thorough rinse with potable water must be performed until the discharged fluid exhibits the chemical and bacteriological characteristics of the supply water.

6.9.4. Construction characteristics

Refer to *A08 ES E CM 01- Annex 08 – Pipework, Fittings, and Ancillaries.*

6.10. Potable and Non-Potable Water Storage Tanks

This specification defines the unit of supply, including documentation and supply conditions in terms of testing and delivery.

6.10.1. Reference standards

- Product Standards
- Legislative Decree No. 31 of 2001
- UNI EN 13445: "Unfired Pressure Vessels"
- Directive 2014/68/EU: On Pressure Equipment (PED).

6.10.2. Documentation to be provided for approval

- Compliance Mark and Declaration of Conformity: As required by the Ministerial Decree of June 26, 1984, Articles 2.6 and 2.7, as amended and supplemented by the Decree of September 3, 2001.
- Construction Drawings: At the scale required by the Project Supervision, reflecting the exact location.
- Pump Head Calculations: Including calculations for submerged pumps.
- Installation Details: Complete specifications and diagrams for proper installation.
- Maintenance Information and Instructions: As defined elsewhere in the tender documentation.
- Test Certificates and Factory Acceptance Test (FAT) Results: Certifications and results for all applicable tests.

Manufacturer's Drawings
The contractor is responsible for ensuring that detailed and accurate construction drawings are produced. These drawings must include: dimensions, positions, and types of all required connections,details of float valve fixings, locations and arrangements for access covers, vents, and other components, detailed requirements and specifications for the base support system.

The drawings must be submitted to the Project Supervision for review to confirm full compliance with requirements.
The cold-water storage tank must be supported as specified by the tank manufacturer and positioned at a height above the ground to allow access to the external flanges located on the underside.

6.10.3. Testing and commissioning

The systems in question must be subjected to a series of tests over time to ensure full compliance with technical specifications and their effective functionality.
The test results must be recorded on forms approved by the Project Supervision. These forms must include at least: the date of execution, the personnel present, the parameters measured, the

recorded values, the design or limit values, and the instruments used. The forms must be signed by the operator who performed the tests and countersigned by the Project Supervision.
The tester will verify functional compliance with the project and, at their discretion, repeat the most significant tests in collaboration with the contractor.
Refer to the content outlined in paragraph 3, along with any additional instructions provided in this section.
The above procedures will be carried out in addition to the Commissioning process as described in the technical report.
The types of tests may include:

- Visual and dimensional inspection
- Verification of the execution of assemblies and the materials used

6.10.4. Construction characteristics

Refer to *A10 ES E CM 01- Annex 10 – Potable and Non-Potable Water Storage Tanks.*

6.10.5. Data sheets and project based specifications

Refer to *MIL05B-BWE-SW-XX-SH-M-50702 Mechanical Equipment Schedule.*

6.11. Electric heating terminal units

This specification defines the unit subject to supply, including the documentation and supply conditions in terms of testing and delivery.

6.11.1. Reference standards

- Normativa di prodotto
- Direttiva macchine 2006/42/EC
- Direttiva bassa tensione (LVD) 2006/95/EC e TH42075
- Direttica compatibilità elettromagnetica 2004/108/EC e TH42056
- CEI EN 60204-1 "Sicurezza del macchinario - Equipaggiamento elettrico delle macchine".
- CEI EN IEC 61000 "Serie Compatibilità Elettromagnetica".

6.11.2. Documentation to be provided for approval

- Installation details.
- Construction drawings, to the scale required by the Site Supervision, reflecting the exact location.
- Maintenance information and instructions as defined elsewhere in the tender documentation.
- Test certificates and factory acceptance test (FAT) results.
- Details of monitoring points for the equipment and communication protocol for interfacing with the building supervision system.
- Electrical schematics.

6.11.3. Testing and commissioning

The facilities in question must undergo a series of tests over time to verify full compliance with technical specifications and their effective functionality.
The test results must be recorded on forms approved by the Project Management. These forms must include at least the following information: the date of the test, attendees, measured parameters, recorded values, design or limit values, instruments used. The forms must be signed by the operator who conducted the tests and countersigned by the Project Management.
The inspector will verify functional compliance with the design and may, at their discretion, repeat the most significant tests in the presence of the Company.
Reference should be made to the provisions of paragraph 3, in addition to any further additions mentioned in this section.
The above-mentioned activities will be carried out in addition to the Commissioning process as described in the technical report.
The types of tests may include:

- Visual and dimensional inspection.
- Verification of assembly execution, materials used, and qualitative assessments.
- Noise testing.
- Verification of declared performance.
- Testing and inspections.

6.11.4. Construction characteristics

Refer to *A12 ES E CM 01- Annex 12 – Heating/Cooling Units for Non-Critical Spaces.*

6.11.5. Data sheets and project based specifications

Refer to Annex *MIL05B-BWE-SW-XX-SH-M-50702 Mechanical Equipment Schedule.*

6.12. Pumps for building services

This specification defines the unit subject to supply, including the documentation and supply conditions in terms of testing and delivery.

6.12.1. Reference standards

- Normativa di prodotto
- Direttiva macchine 2006/42/EC
- Direttiva ecodesign 2009/125/CE
- Norme CEI
- Norme UNI riguardanti sistemi di pompaggio

6.12.2. Documentation to be provided for approval

- Installation details, including specifics of the foundations and drains to be prepared.
- Construction drawings, to the scale required by the Site Supervision, reflecting the exact location.
- Q/H characteristic curves for each pump.
- A table with the technical specifications of the electric motors (including curves showing the variation of efficiency and power factor as power output decreases from the nominal maximum value to 50% of it).
- Drawings of masonry or steel foundations to be prepared for the installation of the units.
- Maintenance information and instructions as defined elsewhere in the tender documentation.
- Test certificates and factory acceptance test (FAT) results.
- Details of monitoring points for the equipment and the communication protocol for interfacing with the building supervision system.
- Electrical power supply schematics.

6.12.2.1. Sizing

For the sizing and selection of pumps, the following guidelines must be adopted:

- The pump head at a closed outlet must not exceed the required head by more than 20%.
- The impeller diameter must be at least one size smaller than the maximum for the selected model, allowing for an increase of at least 15% in the required head.
- The flow rate of the pump at the bottom of the curve must be no less than 1.50 times the required flow rate.
- The electric motor must be sized to account for the maximum possible power absorption based on the pump's performance curve and must provide an absorption capacity of no less than 1.20 times the power required under operating conditions.

- Pump curves must be stable, with a continuous downward slope from zero flow to maximum flow.
- Motors with a nameplate power of 15.0 kW or higher must be supplied with open windings to allow for star or delta connections.

6.12.3. Testing and commissioning

The facilities in question must undergo a series of tests over time to verify full compliance with technical specifications and their effective functionality.
The test results must be recorded on forms approved by the Project Management. These forms must include at least the following information: the date of the test, attendees, measured parameters, recorded values, design or limit values, and instruments used. The forms must be signed by the operator conducting the tests and countersigned by the Project Management.
The inspector will verify functional compliance with the design and may, at their discretion, repeat the most significant tests in the presence of the Company.
Reference should be made to the provisions of paragraph 3, in addition to any further additions mentioned in this section.
The above-mentioned activities will be carried out in addition to the Commissioning process as described in the technical report.
The types of tests may include:

- Visual and dimensional inspection.
- Verification of assembly execution, materials used, and qualitative assessments.
- Noise testing.
- Verification of declared performance.
- Testing and inspections.

6.12.4. Construction characteristics

Refer to *A14 ES E CM 01- Annex 14 – Pumps for building services*

6.12.5. Data sheets and project based specifications

Refer to *MIL05B-BWE-SW-XX-SH-M-50702 Mechanical Equipment Schedule.*

6.13. Pressurization units for hydronic circuits and load management

This specification defines the unit subject to supply, including the documentation and supply conditions in terms of testing and delivery.

6.13.1. Reference standards

- Normativa di prodotto
- Direttiva macchine 2006/42/EC
- Direttiva ecodesign 2009/125/CE
- Norme CEI
- Norme UNI riguardanti sistemi di pompaggio

6.13.2. Documentation to be provided for approval

- Installation details, including specifics of the foundations and drains to be prepared.
- Construction drawings, to the scale required by the Site Supervision, reflecting the exact location.
- Q/H characteristic curves for each pump.
- Schematics.
- A table with the technical specifications of the motors.
- Maintenance information and instructions as defined elsewhere in the tender documentation.
- Test certificates and factory acceptance test (FAT) results.
- Details of monitoring points for the equipment and the communication protocol for interfacing with the building supervision system.
- Electrical power supply schematics.

6.13.2.1. Sizing

For the sizing and selection of pumps, the following guidelines must be adopted:

- The flow rate of the pump at the bottom of the curve must be no less than 1.50 times the required flow rate.
- The electric motor must be sized to account for the maximum possible power absorption based on the pump's performance curve.
- The system must be evaluated to meet the specified performance as a minimum. No tolerance will be allowed.
- The system selection must adequately consider performance degradation due to aging. The amount of performance degradation due to aging must be declared as part of the technical submission of the offer.

- All pressurization units must be capable of operating in technical rooms with temperatures ranging between 0°C and 40°C.
- Where identified elsewhere in the schedules, the equipment must also comply with relevant American codes and standards, such as NEMA, AHRI, c/UL, ANSI/ASHRAE, and CTI.

6.13.3. Testing and commissioning

The systems in question must undergo a series of tests over time to verify full compliance with technical specifications and their effective functionality.
The test results must be recorded on forms approved by the Project Management. These forms must include at least the following information: the date of the test, attendees, measured parameters, recorded values, design or limit values, and instruments used. The forms must be signed by the operator conducting the tests and countersigned by the Project Management.
The inspector will verify functional compliance with the design and, at their discretion, repeat the most significant tests in the presence of the Company.
Reference should be made to the provisions of paragraph 3, in addition to any further additions mentioned in this section.
The above-mentioned activities will be carried out in addition to the Commissioning process as described in the technical report.
The types of tests may include:

- Visual and dimensional inspection.
- Verification of assembly execution, materials used, and qualitative assessments.
- Noise testing.
- Verification of declared performance.
- Testing and inspections.

6.13.4. Construction characteristics

Refer to *A15 ES E CM 01- Annex 15 – Pumps for building services*

6.13.5. Data sheets and project based specifications

Refer to *MIL05B-BWE-SW-XX-SH-M-50702 Mechanical Equipment Schedule.*

6.14. Water treatment

This specification defines the unit subject to supply, including the documentation and supply conditions in terms of testing and delivery.

6.14.1. Reference standards

- Normativa di prodotto
- D.M. n. 443 21/12/1990 - Regolamento recante disposizioni tecniche concernenti apparecchiature per il trattamento domestico di acque potabili;
- D.lgs. 02.02.2001, n. 31 Attuazione della direttiva 98/83/CE relativa alla qualità delle acque destinate al consumo umano.
- D.M. 06.04.2004, n. 174 - Regolamento concernente i materiali e gli oggetti che possono essere utilizzati negli impianti fissi di captazione, trattamento, adduzione e distribuzione delle acque destinate al consumo umano;
- UNI 8065 :2019 + EC 1-2019 Trattamento dell'acqua negli impianti per la climatizzazione invernale ed estiva, per la produzione di acqua calda sanitaria e negli impianti solari termici

6.14.2. Documentation to be provided for approval

- Installation details, including specifics of the foundations and drains to be prepared.
- Construction drawings, to the scale required by the Site Supervision, reflecting the exact location.
- Maintenance information and instructions as defined elsewhere in the tender documentation.
- Details of monitoring points for the equipment and the communication protocol for interfacing with the building supervision system.
- Electrical power supply schematics.

6.14.3. Testing and commissioning

The systems in question must undergo a series of tests over time to verify full compliance with technical specifications and their effective functionality.
The test results must be recorded on forms approved by the Project Management. These forms must include at least the following information: the date of the test, attendees, measured parameters, recorded values, design or limit values, and instruments used. The forms must be signed by the operator conducting the tests and countersigned by the Project Management.
The inspector will verify functional compliance with the design and may, at their discretion, repeat the most significant tests in the presence of the Company.
Reference should be made to the provisions of paragraph 3, in addition to any further additions mentioned in this section.
The above-mentioned activities will be carried out in addition to the Commissioning process as described in the technical report.
The types of tests may include:

- Visual and dimensional inspection.

- Verification of assembly execution, materials used, and qualitative assessments.
- Noise testing.
- Verification of declared performance.
- Testing and inspections.

6.14.4. Construction characteristics

Refer to *A16 ES E CM 01- Annex 16 – Water treatment*

6.14.5. Data sheets and project based specifications

Refer to *MIL05B-BWE-SW-XX-SH-M-50702 Mechanical Equipment Schedule.*

6.15. Containment tanks

This specification defines the unit subject to supply, including the documentation and supply conditions in terms of testing and delivery.

6.15.1. Reference standards

- Normativa di prodotto
- Norme CEI
- Norme UNI
- Decreti relativi allo sversamento sostanze nocive/inquinanti
- Linee guida ARPA

6.15.2. Documentation to be provided for approval

- Installation details.
- Construction drawings, to the scale required by the Site Supervision, reflecting the exact location.
- Maintenance information and instructions as defined elsewhere in the tender documentation.

6.15.3. Testing and commissioning

The systems in question must undergo a series of tests over time to verify full compliance with technical specifications and their effective functionality.
The test results must be recorded on forms approved by the Project Management. These forms must include at least the following information: the date of the test, attendees, measured parameters, recorded values, design or limit values, and instruments used. The forms must be signed by the operator conducting the tests and countersigned by the Project Management.
The inspector will verify functional compliance with the design and, at their discretion, repeat the most significant tests in the presence of the Company.
Reference should be made to the provisions of paragraph 3, in addition to any further additions mentioned in this section.

The above-mentioned activities will be carried out in addition to the Commissioning process as described in the technical report.
The testing includes the following procedures:

- Visual and dimensional inspection.
- Verification of assembly execution, materials used, and qualitative assessments.
- Noise testing.
- Verification of declared performance.
- Testing and inspections.

6.15.4. Construction characteristics

Refer to *A18 ES E CM 01- Annex 18 – Containment tanks*

6.15.5. Data sheets and project based specifications

Refer to annex *MIL05B-BWE-SW-XX-SH-M-50702 Mechanical Equipment Schedule.*

6.16. Wastewater or stormwater drainage networks

This specification defines the unit subject to supply, including the documentation and supply conditions in terms of testing and delivery.

6.16.1. Reference standards

Reference Standards for Piping:

- D.M. 12 dicembre 1985 "Norme tecniche relative alle tubazioni"
- Norme UNI relative alle tubazioni e raccorderia.
- Norma UNI-EN 12056 "Sistemi di scarico funzionanti a gravità all'interno degli edifici"
- Norma UNI-EN 773 "requisiti generali per i componenti utilizzati nelle reti di scarico….
- Raccomandazioni emanate dall'Istituto Italiano Plastici (IIP)

Specific Standards for HDPE/PE Pipes:

- tubi secondo UNI EN 1519
- UNI EN 12666

Specific Standards for PVC Pipes:

- tubi e raccordi secondo UNI EN 1401:

Specific standards for PP pipes

- tubi secondo UNI EN 1451;

Specific standards for Cast Iron Pipes (ghisa)

- tubi secondo EN 877;

6.16.2. Documentation to be provided for approval

- Construction drawings of the networks, to the scale required by the Site Supervision, reflecting the exact location of the networks and their components.
- Annotated drawings showing at least the paths, dimensions, slope, levels, access points, etc., "as built," for the above-ground condensate drainage system.
- Installation details.
- Fireproof coupling certification.
- Details of brackets, insulation, and supports.
- Pipe conformity certificates.
- User and maintenance manuals.
- Include at least the following information for siphons:
    1. Description of the condensate drain siphons.
    2. Names and addresses of suppliers, along with equipment reference numbers.
    3. Copies of all test certificates.
    4. Planned maintenance requirements.

6.16.3. Testing and commissioning

The systems in question must undergo a series of tests over time to verify full compliance with technical specifications and their effective functionality.
The test results must be recorded on forms approved by the Project Management. These forms must include at least the following information: the date of the test, attendees, measured parameters, recorded values, design or limit values, and instruments used. The forms must be signed by the operator conducting the tests and countersigned by the Project Management.
The inspector will verify functional compliance with the design and, at their discretion, repeat the most significant tests in the presence of the Company.
Reference should be made to the provisions of paragraph 3, in addition to any further additions mentioned in this section.
The above-mentioned activities will be carried out in addition to the Commissioning process as described in the technical report.
The types of tests may include:

- Visual and dimensional inspection.
- Verification of assembly execution, materials used, and qualitative assessments.
- Noise testing.
- Verification of declared performance.
- Testing and inspections.

6.16.3.1. Specific tests

Perform all tests and checks to demonstrate that the system meets the requirements of the Building Code and UNI EN 12056.

Inspect and test the installation at the agreed stages and test everything that will be hidden once the work is completed.
Inspect and test the installation at the agreed stages to ensure that the pipes are properly secured and free from debris and materials that may cause blockages, and that all work which will be concealed once finished is free from defects.

If the installation fails the tests, identify the location of the leak, defect, or fault, rectify it, and repeat the test.

All condensate collection trays must be cleaned of any construction debris before commissioning.
The cleaning method for condensate separators must be detailed in the project's operational and maintenance manual.

If not otherwise specified, the following tests and inspections should be performed:

- Load the siphon with non-operating systems and equipment (UTA, FCU) in a static condition.
- Start the connected systems and equipment (dynamic condition) and observe that the siphon ensures proper functioning.
- Shut down the connected system (static condition) and inspect the hydraulic seal to ensure it returns to the same static water level. If the water level is insufficient to maintain a minimum hydraulic seal of 50 mm, the depth of the siphon must be increased. Tests must be carried out in the presence of the director of works or their authorized representative.

Test all branches and connections attached to the main drain. Thoroughly clean all downstream condensate pipes before testing.
When performing the previous operations, take care to remove deposits and other foreign objects and NOT discharge them into the drainage system.

Perform these cleaning operations in the presence of the technician so they can ensure, as far as possible, that the system is clean.

Fully fill the hydraulic seals of all equipment with water before starting the tests.
Perform any necessary repair work at this stage. If the director of works is not satisfied, conduct further tests and cleaning at no additional cost to the employer, as directed by the site management.

Ensure that all siphons maintain no less than 25 mm of seal when subjected to appropriate drainage tests. The number of devices to be tested is detailed in UNI EN 12056-2.

Perform these tests under the supervision of the site management, providing any help and facilities they may need.

Once satisfactory tests have been completed on each individual pipe, branch, and device, reseal all duct covers and replace ceiling panels where necessary.

Arrange for intermediate tests in case part of the system needs to be concealed before the work is completed. If the final tests reveal defects in hidden piping, include the costs of all necessary work to correct the defects.

Perform final tests upon completion to verify the integrity and performance, assisted by the director of works or their authorized representative.

6.16.4. Construction characteristics

Refer to: *A20 ES E CM 01- Annex 20 – Wastewater or stormwater drainage network*

6.17. Irrigation system for green areas

This specification defines the unit subject to supply, including the documentation and supply conditions in terms of testing and delivery.
This project includes the provision of valve chambers for the future implementation of an automated irrigation system.

6.17.1. Reference standards

- Normativa di prodotto
- Direttiva macchine 2006/42/EC
- Norme CEI
- UNI 9182

6.17.2. Documentation to be provided for approval

- Installation details.
- Construction drawings, to the scale required by the Site Supervision, reflecting the exact location.

6.17.3. Testing and commissioning

The systems in question must undergo a series of tests over time to verify full compliance with technical specifications and their effective functionality.
The test results must be recorded on forms approved by the Project Management. These forms must include at least the following information: the date of the test, attendees, measured parameters, recorded values, design or limit values, and instruments used. The forms must be signed by the operator conducting the tests and countersigned by the Project Management.
The inspector will verify functional compliance with the design and, at their discretion, repeat the most significant tests in the presence of the Company.
Reference should be made to the provisions of paragraph 3, in addition to any further additions mentioned in this section.
The above-mentioned activities will be carried out in addition to the Commissioning process as described in the technical report.
The testing includes the following procedures:

- Visual and dimensional inspection.
- Verification of assembly execution, materials used, and qualitative assessments.
- Noise testing.
- Verification of declared performance.
- Testing and inspections.

6.17.4. Construction characteristics

Refer to: *A21 ES E CM 01- Annex 21 – Irrigation System*

6.18. Sitewide pipework and accessories

This specification defines the unit subject to supply, including the documentation and supply conditions in terms of testing and delivery.

6.18.1. Reference standards

Reference Standards for Pipings:

6.18.2. Documentation to be provided for approval

- Construction drawings of the networks, to the scale required by the Site Supervision, reflecting the exact location of the networks and their components.
- Annotated drawings showing at least the paths, dimensions, slope, levels, access points, etc., "as built," for the above-ground condensate drainage system.
- Installation details.
- Fireproof coupling certification.
- Details of brackets, insulation, and supports.
- Pipe conformity certificates.
- User and maintenance manuals.

6.18.3. Testing and commissioning

The systems in question must undergo a series of tests over time to verify full compliance with technical specifications and their effective functionality.
The test results must be recorded on forms approved by the Project Management. These forms must include at least the following information: the date of the test, attendees, measured parameters, recorded values, design or limit values, and instruments used. The forms must be signed by the operator conducting the tests and countersigned by the Project Management.
The inspector will verify functional compliance with the design and, at their discretion, repeat the most significant tests in the presence of the Company.
Reference should be made to the provisions of paragraph 3, in addition to any further additions mentioned in this section.
The above-mentioned activities will be carried out in addition to the Commissioning process as described in the technical report.
The types of tests may include:

- Visual and dimensional inspection.
- Verification of assembly execution, materials used, and qualitative assessments.
- Noise testing.
- Verification of declared performance.
- Testing and inspections.

6.18.3.1. Specific tests

Perform all tests and checks to demonstrate that the system meets the requirements of the Building Code and UNI

Inspect and test the installation at the agreed stages and test everything that will be hidden once the work is completed.
Inspect and test the installation at the agreed stages to ensure that the pipes are properly secured and free from debris and materials that may cause blockages, and that all work which will be concealed once finished is free from defects.

If the installation fails the tests, identify the location of the leak, defect, or fault, rectify it, and repeat the test.

Test all branches and connections attached to the main drain. Thoroughly clean all downstream condensate pipes before testing.
When performing the previous operations, take care to remove deposits and other foreign objects and NOT discharge them into the drainage system.

Perform these cleaning operations in the presence of the technician so they can ensure, as far as possible, that the system is clean.

Fully fill the hydraulic seals of all equipment with water before starting the tests.
Perform any necessary repair work at this stage. If the director of works is not satisfied, conduct further tests and cleaning at no additional cost to the employer, as directed by the site management.

Perform these tests under the supervision of the director of works, providing any help and facilities they may need.
Once satisfactory tests have been completed on each individual pipe, branch, and device, reseal all duct covers and replace ceiling panels where necessary.

Arrange for intermediate tests in case part of the system needs to be concealed before the work is completed. If the final tests reveal defects in hidden piping, include the costs of all necessary work to correct the defects.

Perform final tests upon completion to verify the integrity and performance, assisted by the director of works or their authorized representative.

6.18.4. Construction characteristics

Refer to: *A22 ES E CM 01- Annex 22 – Sitewide pipework and accessories*

6.18.5. Data sheets and project based specifications

Refer to *MIL05B-BWE-SW-XX-SH-M-50702 Mechanical Equipment Schedule.*

6.19. Various accessories

This specification defines the unit subject to supply, including the documentation and supply conditions in terms of testing and delivery.

6.19.1. Reference standards

- Normativa di prodotto

6.19.2. Documentation to be provided for approval

- Construction drawings, to the scale required by the Site Supervision, reflecting the exact location of the terminals and their accessory components (including supports).
- Installation specifications provided by the manufacturer.
- Installation details.
- Performance specifications.

6.19.3. Testing and commissioning

The systems in question must undergo a series of tests over time to verify full compliance with technical specifications and their effective functionality.
The test results must be recorded on forms approved by the Project Management. These forms must include at least the following information: the date of the test, attendees, measured parameters, recorded values, design or limit values, and instruments used. The forms must be signed by the operator conducting the tests and countersigned by the Project Management.
The inspector will verify functional compliance with the design and, at their discretion, repeat the most significant tests in the presence of the Company.
Reference should be made to the provisions of paragraph 3, in addition to any further additions mentioned in this section.
The above-mentioned activities will be carried out in addition to the Commissioning process as described in the technical report.
The testing includes the following procedures:

- Visual and dimensional inspection.
- Verification of assembly execution, materials used, and qualitative assessments.
- Noise testing.
- Verification of declared performance.
- Testing and inspections.

6.19.4. Data sheets and project based specifications

Refer to *MIL05B-BWE-SW-XX-SH-M-50702 Mechanical Equipment Schedule.*

6.20. Building Monitoring System

This specification defines the unit subject to supply, including the documentation and supply conditions in terms of testing and delivery.

6.20.1. Reference standards

- Normativa di prodotto

6.20.2. Documentation to be provided for approval

Documents to be provided for approval:

- Installation details.
- Manufacturer's technical and illustrative documentation.
- General connection diagram of the planned BMS infrastructure.
- Technical data sheets for the components to be installed.
- List of points.
- Wiring diagrams for the control electrical panels.

6.20.3. Testing and commissioning

The systems in question must undergo a series of tests over time to verify full compliance with technical specifications and their effective functionality.
The test results must be recorded on forms approved by the Project Management. These forms must include at least the following information: the date of the test, attendees, measured parameters, recorded values, design or limit values, and instruments used. The forms must be signed by the operator conducting the tests and countersigned by the Project Management.
The inspector will verify functional compliance with the design and, at their discretion, repeat the most significant tests in the presence of the Company.
Reference should be made to the provisions of paragraph 3, in addition to any further additions mentioned in this section.
The above-mentioned activities will be carried out in addition to the Commissioning process as described in the technical report.
The types of tests may include:

- Visual and dimensional inspection.
- Verification of assembly execution, materials used, and qualitative assessments.
- Verification of declared performance.
- Testing and inspections.

6.20.4. Construction characteristics

Refer to *MIL05B-BWE-XX-XX-SH-M-51703*

6.20.5. Data sheets and project based specifications

Refer to *MIL05B-BWE-SW-XX-SH-M-50702 Mechanical Equipment Schedule.*

7. NOISE LIMITATIONS OF THE SYSTEMS

The systems must be designed in such a way as not to generate unacceptable noise levels in the occupied spaces (where required) and in the external environment, and in any case, not exceeding the prescribed levels.
The prescriptions related to noise limits are included in the acoustic impact reports that are part of the design package.
The tests and inspections to be carried out to check the noise levels are listed in section 3, "Technical Testing Standards."
In the event that the noise transmitted by the systems to the occupied rooms or to the outside exceeds the prescribed values, appropriate measures must be taken to bring it within the limits.
These measures may involve:

- The noise sources, for example by replacing the selected equipment with quieter alternatives.
- The insulation of noise sources with acoustic enclosures and protections.
- Treatment of the environment by using the most suitable systems and materials for walls, ceilings, floors, air inlets, and doors to achieve the desired result.

The equipment must be of high quality with adequate acoustic insulation for low frequencies. The manufacturers must detail the related acoustic characteristics.
Circulating pumps must be correctly selected and operated under optimal conditions.
Motors with a rotational speed exceeding 1,500 rpm should not be used unless explicitly authorized.
Where necessary, silencers or other devices must be provided on ducts.
To avoid noise from the expansion of pipes, expansion devices with supports allowing all possible movements must be provided.
The passage of pipes through floors and walls must be carried out in such a way as to prevent the transmission of noise and vibrations to the structure, for example, by using appropriate sleeves.
Pipes must be secured in such a way as to avoid the transmission of vibrations to the structure. Rubber rings can be inserted, and to avoid excessive compression of the rubber, the collars should be two sizes larger than the pipe diameter.
All contact points of sanitary equipment with the structure must be equipped with antivibration devices.
For showers, insulating material must be placed between the structure and the equipment.
To reduce noise caused by water impact in drainage pipes and columns, connections on sub-horizontal collectors must not have an angle greater than 67°.
Particular attention must be given to reducing noise from the substations. The contractor must include all necessary measures in their quotation to ensure that the prescribed noise levels are not exceeded in occupied spaces.
The measures outlined in the technical annex, if required, are the responsibility of the installing company.

Refer to *A100 ES E CM 01- Annex 100 – Noise & Vibration Control.*

8. LIST OF REFERENCE BRANDS

The list below outlines the main brands of equipment suppliers intended for the installation of the systems.

In the case of alternative proposals, they must be quoted by the Contractor, and at the same time, a performance verification of the technical equivalence of the alternative product compared to the one indicated in the project documents must be submitted to the Project Management.

Materials	Approved Brands
Water treatment	Culligan, Termoacqua
Direct expansion systems	LG, Daikin, Mitsubishi
Direct expansion air handling units	Roccheggiani, Daikin
Rooftop-type air treatment units	Roccheggiani, Zoppellaro
Diffusers, grilles, and accessories for primary air and air conditioning systems	Tecnoventil, Trox, Systemair
Control and supervision systems	Schneider Electric, Siemens, Automated Logic
Firefighting system (hydrants and sprinklers)	Bocciolone, Tyco, Viking
Calcium-silicate EI ducts	Roccheggiani, Promat, Aernova
Smoke filter pressurizers	SACOP, Flaktwood
SEFFC/SFM system fans	Aernova, Caoduro, Bovema, , Systemair
Heat pump for DHW production	Vaillant, Ariston
Air dampers and accessories	Tecnoventil, Trox, Systemair
Fire dampers	Tecnoventil, MP3, Systemair
Continuous cooling storage tank	Fiorini, ABC, Pacetti
Firefighting storage tank	GFS Srl
Firefighting pump groups	GFS Srl
Pumping groups and circulators	Grundfos, KSB, WILO
Heating cables	TTK
Leak detection	TTK
Nitrogen generator	Potter
Precision air conditioners	Schneider, Vertiv, Hiref, Stulz
Air heaters/electric heated towel rails	Sabiana
Electric air curtains	Systemair, Flaktwood
Ceiling-mounted heat recovery units	Roccheggiani, Zoppellaro, Sabiana, Systemair
Smoke barriers	Aernova, Caoduro, Bovema
Seismic joints for piping	Bocciolone, Prosystem, Kayse
System supports	Hilti, Prosystem
Aerodynamic system silencers	Lindab, Sagicofim
Black water, stormwater, and system lifting stations	Grundfos, KSB, WILO
PEAD, PE piping	Rototec, +GF+, ISEA
Cast iron piping	Saint Gobain PAM

Materials	Approved Brands
Grease traps, tanks, and purification systems	ISEA, Plastomec, Edilcop
Oil separators for oily water networks	Edilcop
Stormwater attenuation tanks	Acodrain
Precast containment basins in reinforced concrete (RCC)	Edilcop
Manholes for external networks	Edilcop
Hydraulic valves and accessories	Bray, Ksb, Cazzaniga, Giacomini, Danfoss, Caleffi
Pressure-independent control valves	Belimo
Manual flow-limiting valves	Frese
Diesel isolation valves	Bray

9. ANNEXES LIST

- 4024 ES E CM A00 - Annex 00 – Elect Services for Mech Equip
- 4024 ES E CM A05 - Annex 05 - Fan Specifications
- 4024 ES E CM A07 - Annex 07 - Grilles Diffusers and Louvres
- 4024 ES E CM A08 - Annex 08 - Pipework, fittings and ancillaries
- 4024 ES E CM A10 - Annex 10 - Potable and non potable water storage tanks
- 4024 ES E CM A12 - Annex 12 - Heating/cooling units for non critical spaces
- 4024 ES E CM A14 - Annex 14 - Pumps for building services
- 4024 ES E CM A15 - Annex 15 - Pressurization unit
- 4024 ES E CM A16 - Annex 16 - Water treatment
- 4024 ES E CM A18 - Annex 18 – Containment tanks
- 4024 ES E CM A20 - Annex 20 – Wastewater or stormwater drainage networks
- 4024 ES E CM A21 - Annex 21 – Irrigation system
- 4024 ES E CM A22 - Annex 22 – Sitewide pipework and accessories
- 4024 ES E CM A100 - Annex 100 - Noise & Vibration Control

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Electrical Services for Mechanical Equipments
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

Document: A00 ES E CM 01-

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1. INTRODUCTION

This specification details the requirements for Electrical Services for Mechanical Equipment.

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications.

The order of precedence shall be:

- Particular or project specifications included in Electrical Services documentation.
- Data sheet.
- Drawings.
- This specification.

2. ELECTRICAL SERVICES FOR MECHANICAL EQUIPMENT

2.1. General requirements

Unless specifically stated to the contrary within the project documents, all installations, systems and devices within the operational environment of a mission critical facility (e.g. data centre, military establishment, health care facility etc.) shall have any wireless or Bluetooth cards removed or there functionality permanently disabled. All network and communications devices on the local network shall be hardwired.

For general requirements on the electrical services, including the requirements on circuit cabling and support systems, reference shall be made to the project documents and other standard specifications, including but not limited to the below:

- Small Power Installations,
- LV Cable Management,
- LV Cables and Wiring,
- Earthing,
- Electric Vehicle Charging
- UPS
- Interior Lighting
- Emergency Lighting
- IT Cabling and Infrastructure
- Lightning Protection

This specification sets out the additional requirements for electrical services associated with mechanical services not outlined within the aforementioned documentation.

The contractor shall carry out electrical wiring (including associated containment and support systems) for electrical equipment associated with the mechanical services. Which shall include:

- A series of dedicated radial sub circuits,
- Required isolators and switching devices,
- All wiring from switchgear to isolators/equipment,
- Final wiring and connection between isolators and equipment/plant,
- All required containment and supports.

The final sub circuits associated with the Mechanical and Public Health are to terminate within locally mounted switched fused connection units, TPN isolators or directly within the equipment, as denoted within the project documents.

Final connections are to be made with externally rated heat resistant flexible cables.

The final circuit SWA cables shall be labelled with their full circuit reference at either end of the cable and at each change of direction or where the cable passes between walls or slabs. The labels externally shall be engraved traffolyte labels.

For general requirements on the electrical services, including the requirements on circuit cabling and support.

The contractor shall ensure that any organisation carrying out the work on his behalf, or if intended to undertake the work directly, is a current member of the Electrical Contractors Association (ECA) or National Inspection Council for Electrical Installation Contracting (NICEIC) and all operatives have the correct authorisation and competence, for carrying out the work assigned to them. This shall apply to work carried out on or off site.

Unless otherwise indicated, all electrical equipment shall be suitable for use in ambient conditions as given below. Equipment shall be suitably protected against atmospheric corrosion and materials shall not be susceptible to mould growth or attack by vermin, whether, whilst in store, during incorporation into the works or in use.

Although inverter driven soft start motors are preferred, the Contractor shall ensure that the electrical infrastructure is sufficiently rated to account for the starting characteristics of all mechanical plant, including the circuit protective device and cabling.

- This is especially relevant for sprinklers/water mist system and other life plant, where special consideration is required for the starting characteristics on the electrical infrastructure.

2.2. Mechanical and public health plant

2.2.1. Requirements

Provide a series of dedicated sub-circuits for mechanical and public health plant located internally and externally
Fused connection units and isolators (see project documents) are to be provided support mechanical and public health equipment, including but not limited to the below as defined within the project documents:

- Fan coil units,
- Condensers/Compressors,
- CRACs/CRAHs,
- Downflow units
- CDU Units,
- Ventilation plant,
- Chillers and pumps,
- Pump sets,
- Controls associated with the above.

Where required for larger plant, for example chillers, terminate cables directly into the integral control panels.
Where cooling units come with integral automatic transfer switch (ATS), make allowance for local isolators and final connections, unless the particular final equipment selection is suitable for direct connection to the ATS.
In addition to the power supplies for the plant, ensure that power supplies (fused connection units/isolators) are provided to all ancillaries, such as associated controllers, auxiliary power, condensate pumps and branch connection boxes.

- Refer to selected manufacturer's requirements and make allowance for the above.

For split direct expansion (DX) systems, the indoor unit will typically be supplied from the external unit, however the Contractor shall confirm this at Tender stage and shall make allowance for a dedicated internal power supply if necessary, with the particular equipment selection.
Ensure that the cable entry, including space for glanding, bending radii and termination size is suitable for the expected sub-circuit cabling characteristics, whilst maintaining the cable integrity as per the requirements of the relevant standards.

All isolators and cabling methods are to have suitable protection associated with the environment they are located.

2.2.2. Water saving solenoid valves

The contractor shall allow for a switched interface in each toilet to supply and switch the water saver solenoid valve based upon the activation of the local occupancy sensor.
The power supply for the valves shall be via a local switched fused connection unit but shall be controlled by activation of an occupancy sensor.

2.2.3. Sensor Taps

Provide dedicated fused connection units, protected by RCBOs, to sensor taps where these are not battery operated.
Review sanitaryware schedule and ensure that appropriate allowances for power supplies are made for sensor taps.

2.2.4. Trace Heating

Provide a series of dedicated RCBO protected radial final sub circuits for sole use of the trace heating of the pipework.

2.3. Metering

Provide metering to mechanical plant as outlined within the project documents, and at a minimum to meet the requirements of Part L.
Where mechanical plant is supplied directly from main switchgear/switchboards, provide integral meters to switchboards to monitor mechanical plant. Although the metering requirements are defined in the project documents. At a minimum, the metering shall display the following parameters:

- True Power (kW),
- Total Power (kVA),
- Reactive Power (kVAr),
- Maximum Demand - All parameters highest recorded level,
- Total Demand (kWhr),
- Power Factor,
- Frequency (Hz),
- Phase to neutral voltage (L1N, L2N and L3N),
- Line voltage (L1L2, L2L3 and L3L1),
- Amperage per phase (L1N, L2N and L3N),
- Earth Leakage (Current Amps),
- Harmonics (Total harmonic distortion to 63H).

Where required for compliance with Part L and the requirements of the project documentation, provide distribution board sub-circuit metering to monitor mechanical plant.

2.4. Earthing to Mechanical systems

Provide an earthing network including sub-circuit earthing conductors, circuit protective conductors, equipotential bonding conductors and supplementary bonding conductors as required to satisfy the relevant standards.

2.5. Motor Control Panel (MCPs)

Where applicable, provide motor control panels to power and control to mechanical plant and equipment as outlined in the project documents.
Sufficient space shall be allowed to fully open cabinet doors and remove all equipment, a minimum clearance of at least one metre shall be provided in front of panels.
Motor control panels shall either be floor-mounted on a suitable plinth or wall- mounted using adequate fixings, where indicated.
All control panels and assemblies shall be suitable for operation in all normal service conditions as defined in IEC 61439-1.

For normal installations IEC 61010, pollution degree 3 shall be applied to internal installation and pollution degree 4 for external installations.
Any special service conditions for which the panels shall be constructed will be identified in the project documents.

2.5.1. Form of Separation

Panel separation shall be as defined in IEC 61439-2 as outlined in the project documents.

2.5.2. Thermal Imaging

All control panels shall be designed to facilitate a survey by thermographic cameras without the need to expose live parts.
Care must be taken in the selection of materials for screening to ensure that these are "thermally open", with appropriate number of openings to view all connections.

2.5.3. General Construction Principles

All MCPs shall be of a cubiclized type with sections as indicated in the project documents. Each panel shall comprise separate sections, as indicated below:

- Cable handling section,
- Multi-cubicle equipment sections,
- Independent BMS or controls section,
- Power/switching section,
- Base plinths.

Full physical separation shall be provided between power and BMS and / or control sections, which shall have suitably shrouded terminals to permit safe access, whilst live.
All MCPs shall be designed with an allowance of 20% for future component mounting space and cable carrying space. On a cubiclized panel a minimum of two spare bays shall be provided for future expansion.
Where MCPs contain heat generating equipment, such as inverters, they shall be suitably ventilated to prevent excessive heat build-up, with mechanical fans and thermostatic control provided as necessary.
An appropriate level of ventilation shall be provided and where the operating temperature is expected to increase to levels that could cause premature failure then a forced mechanical ventilation system shall be provided.
Certification will be required to show compliance with IEC 61439 with respect to the tests carried out for a temperature rise on load.

2.5.4. Materials and Workmanship

MCPs shall be manufactured in zintec mild steel plate of a minimum 2 mm thickness, which shall be folded, bolted and welded where necessary to form a rigid construction. The panels shall be suitable for freestanding, being backed against a wall, or integrated within items of equipment or plant. Sheet steel shall be truly flat without flaws or blemishes and all edges shall be suitably radiused.
Secondary back plates within panels for fitting internally mounted equipment shall be of mild steel to a minimum thickness of 2 mm being drilled and tapped to accept the internal component fixing screws.
Where possible all equipment shall be modular and utilise a "DIN" Rail form of fixing. Self-tapping screws shall not be allowed.
The back plates shall be suitable for supporting all equipment within any section without visible distortion.
Each section shall have a hinged door with lockable tee-bar handles and contain heat resistant plastic trunking and terminal rails and relays of applicable current rating to enable the connection requirements to be met. All wiring and controls hardware details shall be provided to the manufacturer by the contractor.
The panel shall be fully rated to withstand the prospective short circuit current fault level (three-phase symmetrical) as outlined in the project documents.
All live terminals and components within any panel shall be shrouded in such a manner as to prevent inadvertent contact with them. All live terminals and components mounted on panel doors shall be shrouded such that contact can only be made after removal of the shroud.

All components within the panels shall be rated for continuous operation within the internal panel environment. The panels shall be adequately ventilated where heat generating components are used, with mechanical fans and thermostatic control.
Each panel shall have a skirted plinth section attached to the underside, which should be at least 100 mm high. The maximum height of the panels shall be 2.3 metres.
Each MCP shall be provided with removable lifting eye bolts fitted to the top of the cubicle.
Facilities shall be provided for extension of the MCP at either end of the panel using similar rated bars and shall permit an extension cubicle to be lined up and bolted to the existing panel without access having to be made into the existing panel, except for the purpose of making off bus-bars and bus-wiring to the extension unit. This facility must be shown on the manufacturer's drawings for future reference.
No components shall be mounted on the floor, roof or sides of the enclosure and no component shall be mounted less than 250 mm from the bottom of the panel.
All nuts, bolts and screws securing equipment shall be to metric dimensions and the use of fixings needing special purpose-made screwdrivers, spanners or keys shall be avoided.

2.5.5. Sections

The front of each section shall be fitted with a hinged door, secured by two tee- bar lockable handles (chromium-plated typed) to ensure an adequate seal. All lockable handles shall be openable with one key. The hinges shall be internal, mounted in opposing senses so that the doors cannot be removed inadvertently and shall enable the door to open through an angle of 120°.
Each section of each MCP shall be fitted with separate back plates on which components shall be mounted and shall be of sufficient size to accommodate these plus sufficient access space to allow maintenance to be carried out with reasonable safety. In addition, the back panel of each compartment shall have space for 25% increase in control hardware. The manufacturer may use swing- out mounting plates in addition to the above in order to improve utilisation of space and access to components.
All doors and covers shall be of dished construction and fitted with a dust and damp protective seal. This shall be tubular neoprene or other suitable material, firmly fixed to a rebate on the door. If the Contractor cannot supply such a seal arrangement this must be stated in the Tender return.

2.5.6. Fixings

No item of equipment secured within the control panel shall incur penetration of the main cabinet for riveting, bolting, etc.
Internal chassis plates shall be used for fixing of items and the chassis plate shall be spaced in from the cabinet on brackets welded to the cabinet interior.
All fixings visible from the front face of the panel shall be countersunk hexagon socket head set-screws, chromium plated with consistently sized visible heads used.

2.5.7. Site Conditions and Protection

All items of equipment mounted on or within a panel shall be suitable for ambient conditions. Precautions shall be taken to prevent damage or deterioration of panels during transit and to afford protection on site prior to final acceptance.
For freestanding panels protection shall take the form of a full plywood enclosure, which shall be capable of removal and replacement during the installation period. The enclosure shall fully protect the panel finish, internal and external components.
The enclosure shall be capable of protecting against the ingress of moisture from an incomplete structure. Any panels scratched, marked or otherwise damaged shall be returned to the manufacturer for re-finishing. All consequential costs shall be at the Contractor's expense.
The Contractor shall, prior to commissioning, fully clean the panels internally and externally prior to handover.
The cleaning shall include vacuum removal of dust and small items of debris, removal of old drawings, tools, etc. External cleaning shall be via polishing with a good quality automotive non-abrasive polish.
A full set of wiring diagrams shall be placed within the panel, together with any specialist "short form" instruction booklets. All "spare fuse" locations shall be fitted with the correct rated fuses.

2.5.8. Cable Access

The cabling handling section shall be a compartment at the top of the MCP. The section shall be full width and of sufficient height to accommodate a linear arrangement of insulated, screw terminal, rail-mounted connectors, for termination of all outgoing and incoming cabling and bending radius of all incoming single conductors.
Cabling shall be routed via a removable gland plate bolted to a reinforced horizontal section of the top panel of the cabinet, above, but offset from the terminal strips. The gland plate shall be in several sections for minimum disturbance during any subsequent modifications.
Adequate space for main incoming cables shall be assessed based on confirmation of the relevant cable sizes. A rectangular copper earthing bar at 25 x 3 mm minimum shall be provided along the full length of the Control Panel at the top front and adequate bonding shall be provided to all non-conducting metalwork and gland plates.
Internal metalwork supports and mounting frames shall be manufactured from zinc-coated steel for improved earth continuity.

2.5.9. Electrical Construction

The incoming AC supply shall be as specified in the project documents.
The internal starter control, indication and solenoid supplies shall be at as outlined in the project documents.
The Contractor shall adhere to the requirements of IEC 61131, particularly concerning safety, extra-low voltage and segregation.
Without exception, all equipment shall be safe to personnel under normal operation and maintenance conditions encountered in the supply system to which it is connected.
All equipment shall "fail-safe" under all conditions of operation. The requirements of safety and "fail-safe" apply to mechanical, operational and electrical aspects of the equipment, but the use of protective devices and / or interlocks to render the equipment safe under abnormal conditions is accepted.
It shall be possible to gain access to, and work on a faulty item of equipment without having to remove or partly dismantle any other item, including safety shrouds of other circuits, or disturb main current carrying connections and small wiring not directly connected to the faulty item.

2.5.10. Busbars

The complete busbar assembly shall be enclosed in its own compartment and shall be capable of withstanding the maximum possible mechanical stresses to which it may be subjected under fault conditions without distortion.
Each bolt used for securing bus bars shall have a coating of epoxide resin-based bonding compound applied to the treads at the final position of the nut or bolt.
The strength of the final bond shall be such that the torque required to loosen the connection shall be at least five times the initial torque setting. All bolts shall have the torque setting identified within the panels.
All functional devices shall be connected by means of solid copper busbars unless agreed otherwise (in writing) by the Engineer. Full provision shall be made to all busbars within the assembly for carrying out thermal imaging maintenance routines of the busbar connections and busbar / cable joints throughout the assembly.
Busbars shall be air insulated, unless otherwise detailed in the schedules. Bus- bar chambers shall run horizontally or vertically and shall contain three-phase and neutral busbars. Provision shall be made to allow the busbar to be extended at both ends. Access to the bus-bar chamber shall be gained by the removal of covers secured by bolts or screws.
Where specified elsewhere the busbars shall be covered by a suitable bus-bar sleeving, including bus-bar connections and joints.
Busbars shall be manufactured using hard drawn high conductivity copper, adequately braced to withstand the proposed fault level for 1 second, full sized, three phase and double rated neutrals where specified on the attached drawings or detailed in the schedules.
Metalwork for the busbar supports shall be non-ferrous to prevent the circulation of eddy currents.
Insulation shall be applied to all bus bars, including busbar supports, and these shall be non-hygroscopic and non-deteriorating. Fibrous materials, linseed oil, varnish or the like will not be permitted.

2.5.11. Earthing

Earthing facilities shall be provided for each control panel. The control panel earth terminal shall consist of a threaded brass stud and be readily accessible from the front of the panel. The earth stud shall be secured using brass nuts and washers and arranged to be in direct contact with the panel metalwork.

An earthing bar of 25 x 3 mm copper shall be installed along the whole length of each panel and secured solidly to the panel metalwork.
A separate earth cable shall be taken from each compartment earth terminal to the earthing bar.
The earth bar shall separately connect each outgoing motor circuit and be readily accessible from the front of the panel.
Final connections from outgoing cables to the earth bar shall be via a proprietary earth connection at the gland and suitable sized circuit protection conductor sized in accordance with IEC 64-8.
All earth terminations shall be labelled using engraved traffolyte secured with cable ties.
Each cable gland plate shall be bonded to the earth rail by means of a flexible copper braid sized in accordance with CEI 64-8.
Each compartment door equipped with any components shall be fitted with an earth terminal which shall be bonded to the main earth system by means of a flexible copper braid.
In addition, all components which have an earth terminal and are mounted on cubicle doors shall be wire bonded to the earth system. Removal of any component from the door shall not break the earth continuity to any other components on the door.
The size of the earth braid to the door shall have a cross-sectional area of not less than that of the largest wire connected to any components mounted on the door.
Circuit protective conductors shall be installed between the earth bar and all doors, gland plates, mounting plates and external and extraneous conductive parts of panel components.
A safety notice shall be fixed adjacent to the main earth terminal internally and externally. This shall be "SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE" in characters 10 mm high coloured red on white Traffolyte. In English and Local Language.

2.5.12. Incoming Supply Compartment

MCPs shall be equipped for the reception of each incoming cable shown on the drawings. The protection to the incoming cable will be as shown on the appropriate drawing and termination arrangements must be suitable for the specified cables.
This shall include spreader boxes to cater for larger cable sizes with large bending radii.
Each incoming supply section shall be equipped with instrumentation as per the project documents.
Each incoming supply section shall be fitted with means of three-phase and neutral isolation, as detailed in the project documents.
The manufacturer shall arrange the internal layout of the panel to ensure maximum safety to personnel working inside the panel. All "live" parts shall be fully shrouded, with clear warning labels.

2.5.13. Protection

All mains circuits within a Motor Control Centre shall be protected by means of suitably rated moulded case circuit breakers or HRC cartridge fuses manufactured to IEC 60269-2, EN 88-2, as outlined in the project documents.
Each single drive outgoing circuit shall have its protection contained solely within a dedicated service.
Where more complex circuits occur such as those for two-speed drives, additional protection shall be provided for individual sub-circuits, as indicated on the schematic diagrams.
Protection ratings for power circuits are outlined in the project documents.
Connections from the panel busbars into compartments are outlined below.
Fuses shall be used for protection of metering and protective circuits. These shall be of the type described above and mounted in similar fashion to fuses used for power circuit protection.
Protection ratings shall be such that adequate discrimination, be provided throughout the panel.

2.5.14. Motor Starters

Protection co-ordination within MCPs shall be such that in the event of a short circuit fault, all starters shall be undamaged, with protection co-ordination to IEC 60947. This shall be based on the appropriate fault levels shown elsewhere in the specification and schedules.
Any constituent part of the starter which, by performance of its design function, automatically disconnects the electrical supply to the drive as a safety measure (e.g. thermistor, overload, etc.) shall not automatically re-set, but rather shall require to be manually re-set
All starters shall be in conformity with the relevant IEC and shall be provided with the auxiliary contacts and overload protection devices suitable for the rating of the motors which are to be controlled.

Generally, the overload protection for motors shall be by a three-phase, ambient temperature compensated thermal overload device incorporating single phasing protection. Unless otherwise specified the devices shall be re-set manually from within the starter compartment only.
The overload shall comply with IEC 60947 and, following a fault above the overload capability of the starter, no damage must ensue other than the rupture of the relevant fuse(s).
All motors enclosed by ductwork, i.e. hidden from direct view, shall be provided with thermistor protection and, therefore, the necessary manually re-set relay shall be incorporated in the control gear for these drives.
All devices deriving power from control panels shall be provided with separate starters suitable for the motor duty and AC1 duty rated if no other duty is indicated within the schedules. All starters shall comply with IEC 60947.
Motor loads up to 0.375 kW shall be single–phase. Loads in excess of 0.375 kW shall be for three-phase operation.
Loads up to 5.5 kW shall be Direct-On-Line (DOL) start.
Loads greater than 5.5 kW and up to 20 kW shall be for Star-Delta (SD) starting.
Loads greater than 20 kW shall have electronic soft start to limit the starting current to no greater than 125% FLC unless otherwise specified.
Motor control gear for Direct-On-Line starting shall consist of main circuit fuses, contactor, thermal overload relay and selector switch, mounted on the panel fascia to select manual or automatic operation, labelled "Manual-Off-Auto" and indicator lamps for "Running", "Stopped" and "Tripped" indication.
Star-Delta started motor control gear shall consist additionally of main, star and delta contactors, including inhibiting controls to prevent the motor being started from rest in delta connections. Suitable resistors shall be included as necessary on changeover from star to delta, or as an economy resistor where DC controls are used.
Overload relays shall be thermal types to IEC 60947 with protection to all phases and single phasing protection. Where used for Star-Delta starters, the overload shall be in the line connection and shall provide protection under both star and delta connection conditions, by the appropriate method to comply with the above criteria.
Multi-speed motors shall always be started at low speed and be automatically transferred direct from the low to high speed winding when a higher speed is required.
Multi-speed motors shall be provided with appropriate overload protection for all speed conditions.
Contactors shall be rated at least 25% above the motor rating with a minimum rating of 2.5kW at utilisation category AC1, to comply with EN IEC 60947.
Motor circuit wiring fuses shall have a minimum rating of 10 A. Separate sets of fuses shall be provided for each starter circuit as detailed elsewhere in the specification.
Where detailed in the project documents, power factor correction capacitors shall be provided and included within the motor control panel. Sufficient liaison shall take place with suppliers of motors and equipment, to ensure that the correct sized capacitors are chosen to improve the power factor to minimum 0.95 lagging. Operation of the power factor correction shall be staged and automatic with the equipment usage.
Facilities shall be incorporated to discharge the capacitors when the equipment is not running. Fuse protection shall be provided to the capacitors.
When variable speed drives are electronically controlled and the harmonic current is low, then reactor connected capacitors to prevent resonance shall be provided. Where harmonic currents are high, then a tuned filter to suppress the harmonic current shall be provided. Tests shall be carried out and certificates issued to show that the selections of filters and capacitors is correct and reducing harmonic current to acceptable levels of circa 3-5% THD.
Components shall be arranged on the panel back plate in a neat and orderly manner. The order of components arranged from top to bottom shall be fuses, contactors and associated relays and at the bottom the overload relays. Terminal blocks shall be arranged at top side or bottom, to suit the particular requirements of the installation, allowing sufficient space for cable glands and internal connections. All spare cores on control cables shall be terminated into the relevant Klippon terminal block and the terminations labelled "spare".

2.5.15. Contactors

All contactors shall be of the air break type. The thermal rating of each contactor shall be equal to, or in excess of, the continuous current rating of the associated circuit.
Contactors shall be designed and rated to IEC 60947, the category of duty shall be AC3 and suitable for the duty shown on the drawings or specified elsewhere.
All shall be suitable for continuous use.
Where protection against simultaneous operation of two is required, such as on "forward" and "reverse" motions, interlocking shall be mechanical and / or electrical.

At least two normally OPEN and two normally CLOSED contacts shall be provided on each contactor in addition to the quantity required to achieve the design parameters.
Normal motor duty shall be taken to be 30 starts per hour, but for duties in excess of this, thermistors shall be embedded in the motor windings to provide overheating protection. The necessary manual re-set thermistor control relays are to be fitted in the respective starter compartment.
Where Duty 1 and Duty 2 motors are provided for the same item of plant, the starter / control gear associated with each motor shall be situated in different compartments and the selection of drives shall be made with an appropriate selector switch, as described in this Section.
In addition, hard wired interlocking, by direct means or by relays, shall be provided between Duty 1 and Duty 2 drive starters to prevent simultaneous operation. This shall only occur in the "auto" mode.

2.5.16. Control Supplies

A dedicated section in each MCP shall be included to house the air-cooled control transformers.
The primary windings of the transformers shall be protected by means of HRC fuses mounted in the compartment. The front of the fuses shall be completely shrouded with a Perspex sheet, fixed to the back of the compartment on suitably insulated mountings and the transformers shall be clearly labelled.
One line of the transformer secondary shall be connected to the panel earth bar. An earthed screen connected to the panel shall be provided between the windings.
The outgoing control circuits shall be protected by means of a double pole Type III miniature circuit breaker (MCB) of fault rating M3 mounted on DIN rail.

2.5.17. Control Relays

All control relays shall be of the plug-in type, as required. The relay units are to conform to the requirements of IEC 60255 with regard to creepage and clearance distances.
The relays shall be suitable for operation from an external source and the coils are to be compatible with the selected control circuit voltages. The contacts of the relay shall be rated at not less than 5 A, 230 volts, 50 Hz single- phase and each relay shall be fitted with 3-pole changeover contacts.
The base holder for the plug-in relay shall be 11 pin type and the connectors for terminating the incoming cables to the base holders shall be by means of screw type terminals accessible from the front.
The plug-in relay units shall be fully enclosed to prevent the ingress of dust or moisture. The enclosures shall be made from a clear polyurethane or acrylic material and shall have the connection diagram of the relay unit imprinted on the top.
All relay units shall be fitted with a spring retaining clip to ensure proper connection of the relay when fitted to the base holder. Each panel shall be fitted with a dummy base and spare relay.

2.5.18. Control Switches

Manually-operated control switches shall consist of four main types – "On / Off", "Hand / Off / Auto", "Duty 1 / Duty 2" depending upon the application and shall be of the quick make and break type using double break contacts operated by a common spindle.
Control switches shall have a rotary action with invisible fixing to the appropriate part of the panel as described below and shall be of the same suite as the indicator lights and pushbuttons.
"Local / Off / Remote" selector switches shall be provided to items of equipment not under automatic control. Provision shall be made with appropriate compartments for the termination or remote switching controls.
"Hand / Off / Auto" selector switches shall be provided for single drives or supplies to packaged equipment, where the normal mode would be under automatic control (Auto) and the "Hand" position would be used during maintenance. These switches shall be mounted on the panel fascia.
Where Duty 1 and Duty 2 motors are indicated on an item of plant a "Hand / Off / Auto" switch shall be provided. The switch shall have four positions, "Duty 1", "Duty 2", "Off", "Auto".
Control switches with an "Auto" position, as detailed above, shall be provided with the appropriate wiring, relays, auxiliary contacts and direct connections to the control section interface compartment, to monitor which position has been selected.
Complete details of the connections and wiring shall be provided to the manufacturer by the Contractor.

2.5.19. Pushbuttons

These shall be of the standard duty, double break contact block type with chromium flush-mounting bezel and coloured operating push. The buttons shall be of the circular pattern.
-

2.5.20. Indicator Lights

Indicator lights shall be provided for defined plant operations and shall be of the transformer-operated pattern.
Each unit shall be mounted on the respective compartment door and sited with the appropriate switches. All lamps must be replaceable from the front without the use of special tools.
Where indicator lights and pushbuttons are provided together on any compartment cover they shall be of the same suite.
Indicator lamps shall be of the "push-to-test" variety.

2.5.21. Instruments

All measuring instruments such as ammeters and voltmeters, shall be square fronted, flush-mounting, gloss black bezel pattern of the pivot less moving iron type.
The scale shall be over a 90 arc and of continuous length 50 mm or above for motor circuit ammeters and 70 mm minimum for instruments in any incoming circuits to the panel.
All analogue instrumentation shall comply with EN IEC 60051 and digital instrumentation with EN IEC 62053.
Any voltmeters or power meters incorporated on the panel shall be fused in both voltage lines.
All wiring to instrumentation both digital and analogue shall be neatly bound or run in flexible conduit and separately fused.
All watthour meters for active energy, shall comply with IEC 62053-11 with an accuracy of +/- 1% (Class 1), and have a calibration certificate for each meter.
All static meters for secondary metering and sub metering shall comply with EN 62053 in all respects.
All instruments and meters shall be flush front panel mounted and shall be segregated in instrument compartments.
Metering shall be connected via the panel control circuit and all communication from meters shall be connected to the building management system (BMS) or power control system (PCS) as detailed in the schedules. The metering software shall be configured to enable complete flexibility in the display and recording of the energy consumed by the electrical installation.
As a minimum the metering shall display the following parameters:-

- True Power kW
- Total Power kVA
- Reactive Power kVAr
- Maximum Demand - All parameters highest recorded level
- Total Demand kWhr
- Power Factor
- Frequency Hz
- Phase to neutral voltage L1N, L2N and L3N
- Line voltage L1L2, L2L3 and L3L1
- Amperage per phase L1N, L2N and L3N
- Earth Leakage Current Amps
- Harmonics Total harmonic distortion

Where instruments or protective relays are mounted on panels, these panels shall be hinged to permit access to the terminals and wiring at the rear of the instruments. Vertical hinging shall be provided. Terminals at the rear of any instrument shall be adequately shrouded and labelled.
The ammeter scale shall be suitable to allow for motor starting current, i.e. with an extended range above the full load current.

2.5.22. Current Transformers

Current transformers shall comply with IEC 61869-2. They shall be mounted on the fixed portion of the switchgear on the circuit side of circuit breakers, remote from the busbars.
Meter current transformers shall have a 1 A full load current secondary winding. No current transformer shall be used for more than one function.
The secondary of each current transformer shall be solidly connected to earth at one end.
The minimum rating of current transformers shall be 7.5 VA.
Current transformers shall be accurate and operate across the full range of the equipment connected to. They shall be class 35P/10P for protection relays and Class 1 for metering.
All current transformers shall incorporate test facilities on the secondary side, in the form of test points to check the accuracy of the meters and protection devices.

2.5.23. Painting, Labelling and Identification Painting

All panels shall be de-greased, etched, primed and provided with a minimum of two coats of powder coat finish.

2.5.24. Labelling and Identification

All key components within each compartment shall be clearly identified by a firmly secured label bearing the device reference shown on the schematic diagram.
The wording format and style of the label is to be specifically agreed, in writing, with the Engineer.

2.5.25. Testing, Inspection and Commissioning at Manufacturers' Works

The following Tests shall be carried out for each control panel before the panel is despatched from the manufacturers works:

- Visual inspection.
- Inspection of provisions for cable entries.
- Checking access, type of cable gland, etc.
- Any other tests included in electrical documentation or commissioning docs.

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Fan Specifications
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

Document: A05 ES E CM 01-

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1. INTRODUCTION

This specification details the requirements for fans, used for air movement within and around buildings.

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications.

2. TECHNICAL REQUIREMENTS

2.1. Standard requirements

All fans used shall comply with the European Directive 2009/125/EC EU "Energy Efficiency Directive" which states the minimum energy efficiencies which must be achieved by fans and their associated drive systems.

Fan performance and testing is based on standard arrangements for duct entry and discharge. Site installation constraints often require departure from these standards. The Contractor shall make appropriate allowance in the revision of the fan operating resistance to take account of this. Where necessary guide vanes or duct splitters shall be used to improve suction and discharge conditions.

All fan resistances stated have been calculated based on a particular selection of equipment. The installer shall recalculate the total system resistances based on the final selection of plant and installation drawings and revise the fan resistance as necessary to achieve the design air volume flow. Similarly, if the fan power requirements and sound power level changes, the installer shall reselect the necessary motor size, wiring and suitable attenuation to achieve the noise levels stated elsewhere at no additional cost.

The contractor shall ensure that fan resistances take account of pressure drop across filters in accordance with the Final Pressure Drop column of the following table:

Filter Class	Initial Pressure Drop	Final Pressure Drop
G1 – G4	75 Pa	150 Pa
F5 – F7	100 Pa	200 Pa
F8 – F9	150 Pa	300 Pa

Individual components shall, in addition to the requirements of this section, comply with other relevant sections of this specification.

Fans shall be installed in a manner strictly in accordance with the manufacturer's recommendations.

Fan impellers shall be statically and dynamically balanced at the works of the manufacturer and test certificates issued to the Engineer.

Manufacturer's test certificates, acoustic data and fan curves shall be submitted to the Engineer, fan curves shall indicate performance under all likely operating conditions.

Fans shall be constructed to proven design standards and shall be capable of withstanding the pressures and stresses developed during continuous operation at the selected duty, during starting, during stopping and during speed and duty changes. Fan casings shall be of substantial construction, adequately stiffened and braced to prevent vibration and drumming. Bolted inspection covers shall be provided to allow easy access to internal working parts. Lubrication points shall be extended to accessible positions external to the casings.

Externally mounted fans and internal exposed surfaces on fans handling outside air shall be protected against corrosion.

Fans and drives shall be resiliently mounted. Mountings and supports shall be arranged to prevent undue movement of fans relative to adjacent ductwork systems or building structure.

Fans and drives shall be mounted on rigid base-frames or support structures to ensure that proper alignment is maintained.

All fan casing shall maintain better than the Class declared in UNI EN 1507.

2.2. Installation

All fans shall be mounted in positions that allow adequate space for maintenance both of the fan and the motor.

All fans shall have flexible connections constructed from sound barrier mat to prevent vibration being transmitted to ductwork systems. The barrier mat shall not exceed 150 mm in length without distortion, the density being sufficient to prevent a plant room noise level of greater than 85 dB(A).

2.3. Motors and drivers

Unless otherwise stated all fans shall be direct drive with EC direct current motors or inverters to provide variable speed drive. Exceptions, for example toilet extract or domestic fans shall be agreed with the Engineer.

Each motor shall comply with CEI EN 60034 "Rotating electrical machines" and shall be of such a size and type to start and drive the equipment under normal conditions of service without overloading.

Where mounted in external air, or highly moisture laden atmosphere, they shall be weatherproofed or separately protected. Motors in hazardous atmospheres shall be flameproof, certified to CEI EN 60079 "Explosive atmospheres".

Nameplates shall be positioned so that they are readable from normal access positions.

Motors arranged for automatic starting shall have a label of durable material, not less than 150 mm x 100 mm in size, permanently affixed in a prominent position and having, in clearly inscribed characters, the legend: In English and local Language.

DANGER

This motor is automatically controlled and may start without warning.

Isolate before inspection

Where vee-belt drives have been specifically agreed with the Engineer they shall comply with the following:

- ISO 254 "Belt drives. Pulleys. Quality, finish and balance"
- ISO 8419 "Belt drives. Narrow V-belts. Sections 9N/J, 15N/J and 25N/J (lengths in the effective system)"
- UNI ISO 5290 "Belt drives. Grooved pulleys for narrow V-belts. Groove sections 9N/J, 15N/J and 25N/J (effective system)"
- ISO 9982 "Belt drives. Pulleys and V-ribbed belts for industrial applications. PH, PJ, PK, PL and PM profiles. Dimensions"
- A minimum of two belts shall be provided and the drive sized so that the rated output of the motor can be transmitted with one belt removed. A complete set of spare belts shall be provided.

All motors shall comply with the following unless otherwise stated:

- Minimum IE2 efficiency with frequency converter
- -200°C to +400°C operating temperature range
- Class F motor insulation
- IP55 enclosure rating
- Thermal overload protection

Local electrical isolation shall be provided for all individual fans of the correct voltage, current rating and number of poles to disconnect all lines including neutral.

2.4. Safety

All power transmission shafts, belts and pulley drives shall be guarded and be in compliance with UNI EN ISO 12499 "Industrial fans. Mechanical safety of fans".

Fan guards shall be purpose-made by the manufacturer or to the approval of the manufacturer and be constructed from galvanised or plastic-coated steel wire.

Guards shall be installed to prevent inadvertent contact with dangerous parts of machinery and the mesh size and/or the location of the guard shall prevent finger contact with any enclosed danger point.

Construction and installation shall ensure strength and rigidity and it shall not be possible to remove any guard or access panel without the aid of a tool.

Where required removable access panels shall be provided to permit tachometer readings to be made of motor and drive shafts and belt tension to be tested.

For duplicate motor installations, the guard provided shall be designed to protect both drives. All fixings and mountings shall be installed to facilitate change-over of the drive.

2.4.1. Attenuation

Attenuation shall be applied to all fan systems to ensure that the specified noise criterion is maintained.

Attenuators shall be positioned as close as possible to the fan to limit noise breakout but must be independently supported.

Careful consideration must be given to the ductwork design of the connection, particularly on the discharge since poor ductwork design will lead to unnecessary pressure losses.

Refer to standard specification for Noise and Vibration Control.

2.5. Standard fans type

2.5.1. Centrifugal Fans

Unless otherwise indicated all centrifugal fans shall be direct drive with speed control. The choice of backward, forward or aerofoil blade impeller shall be decided on the basis that the one offering the highest efficiency for a given duty shall be used.

Fan casings shall generally be constructed from galvanised mild steel sheet, with welded or riveted joints and welded angle stiffeners, constructed to permit withdrawal of the fan impeller. Casings shall be rigid without deflection, drumming or excessive vibration.

For toxic or hazardous applications, the fan casing shall comply with the ATEX requirements and be gas tight and of all welded construction.

Finishes and materials of construction shall not be affected by gases handled by the fan or the local environment.

The suction inlet shall be of the curved aerofoil profile to streamline the airflow into the impeller and of adequate diameter to allow withdrawal of the impeller without splitting the fan scroll.

A drain connection shall be provided at the base of the fan scroll.

Permanent indicators shall show the direction of rotation of the impeller. Casings shall have access panels incorporating air seals to facilitate cleaning and maintenance of the impeller.

The fan outlet shall be flanged and drilled to suit connections to the ductwork system flexible connections.

Unless otherwise stated impellers shall be constructed of mild steel and protected against corrosion. Impellers shall be keyed to the driving shaft or fixed with tapered bush fittings.

Each fan impeller shall be supported by an individual bearing system. Bearings shall be ball or roller type and shall be self-aligning. Indirectly driven fans shall be provided with pedestals incorporating two bearings. Bearings on the non-driven side of the fan shall be provided with a scroll stiffening framework supported from the fan base to maintain bearing position and alignment.

The impeller shaft shall be of solid mild steel, protected against corrosion, or stainless steel adequately sized such that its first critical speed is not reached before the design fan speed is obtained.

Belt-driven centrifugal fans and drive motors shall be located on a common base. Anti-vibration mountings, to prevent the transmission of noise or vibration to the structure, shall be provided as indicated elsewhere.

2.5.2. Axial Flow Fans - Duct Mounted

Axial flow fans shall be of the long or short casing pattern, as indicated, with a heavy gauge, mild steel casing flanged and drilled at each end. Casings shall be hot dip galvanised and be fully airtight.

Axial fan motors shall have non-overloading characteristics within the normal working range.

Fans shall be suitable for either vertical or horizontal mounting. They shall be supplied complete with matching flanges, flexible connections and anti-vibration mountings.

Air-tight inspection doors shall be provided giving access to fan impeller and motor and other components requiring regular servicing or maintenance.

The impeller shall be multi-blade aerofoil section constructed from high density PVC, reinforced glass fibre, or die-cast aluminium alloy with provision for manual adjustment of the blade angle.

Rotors shall be statically and dynamically balanced. They shall, when requested, be subject to X-ray tests and documented results shall be submitted. Impellers for variable pitch fans shall in addition be checked over the full blade angle range for

vibration in accordance with ISO 20816-1 "Mechanical vibration. Evaluation of machine vibration by measurements on non-rotating parts. General guidelines".

Multi-stage fans shall be arranged with contra-rotating stages. They shall be coupled together in the sequence and arrangement recommended by the manufacturer.

Motors in the air stream shall be pre-wired to the external electrical terminal box through weatherproof flexible conduit rated all rated at IP55.

Safety guards shall be provided on air inlet and air outlet connections where these are freely accessible to personnel.

Variable pitch axial fans shall comply with the requirements of the axial flow fan clause.

Fans with automatically variable pitch shall be controllable through a range of sufficient angularity to vary volume and pressure across the system design range.

The variable pitch mechanism and control actuator shall give fully modulated control of the fan air volume rate to match the system characteristic as indicated.

Pitch angle control shall be provided from sensors provided as part of the control system. Safety facilities shall be incorporated to prevent blade settings being increased beyond the maximum design.

2.5.3. Axial Fans - Bifurcated

Bifurcated axial flow fans shall be constructed from heavy duty galvanised mild steel designed to ensure that the motor is not within the airstream.

Design operating temperature shall be as indicated in the schedules. High temperature units shall be suitable for operation in air stream temperatures up to 230°C unless otherwise stated.

Axial fan motors shall have non-overloading characteristics within the normal working range.

The impeller shall be multi-blade aerofoil section constructed from die-cast aluminium alloy, or other material suitable for the duty.

Rotors shall be statically and dynamically balanced. They shall, when requested, be subject to X-ray tests and documented results shall be submitted. Impellers for variable pitch fans shall in addition be checked over the full blade angle range for vibration in accordance with ISO 20816-1 "Mechanical vibration. Evaluation of machine vibration by measurements on non-rotating parts. General guidelines".

Motors shall be wired, by the Contractor to the external electrical terminal box through weatherproof flexible conduit all rated at IP55.

Fans shall be suitable for either vertical or horizontal mounting. They shall be supplied complete with matching flanges, suitably rated flexible connections and anti-vibration mountings.

2.5.4. Axial Flow Fans - Plate or Ring Mounted

These shall be ring or plate mounted as indicated in the schedules.

Impellers shall be constructed of mild steel protected against corrosion, aluminium or as a one-piece polypropylene moulding and comprise 3 or 4 blades. The impeller shall be secured fixed to the motor shaft with key and keyway, locked by a setscrew.

The impeller shall be fixed to the plate or ring by heavy duty steel arms with an anti-vibration mounted incorporated between the arm and the plate.

The plate or ring shall be manufactured from heavy gauge steel, galvanised or powder coated with pre-drilled fixing points.

The motor shall be suitable for continuous operation and a sealed electrical terminal box shall be provided.

Safety guards shall be provided on air inlet and air outlet connections where these are freely accessible to personnel.

The fan shall be capable of reverse flow. They shall be supplied with purpose made speed control units as provided by the manufacturer.

Non-return shutters shall be fitted to all fans discharging externally to the building or where indicated.

Motors shall be pre-wired to the external electrical terminal box through weatherproof flexible conduit rated all rated at IP55.

2.5.5. In Line Centrifugal Fans

Unless otherwise indicated all in line centrifugal fans shall be direct drive with speed control. The choice of backward, forward or aerofoil blade impeller shall be decided on the basis that the one offering the highest efficiency for a given duty shall be used.

Fan casings shall generally be constructed from galvanised mild steel sheet, with welded or riveted joints and welded angle stiffeners, constructed to permit withdrawal of the fan impeller. Casings shall be rigid without deflection, drumming or excessive vibration. For fans with an impeller diameter less than 250 mm aluminium or plastic casings may be used.

Fans with an impeller size greater than 250 mm shall have removable access in order to maintain internal components.

Motors shall be pre-wired to the external electrical terminal box through weatherproof flexible conduit rated all rated at IP55.

Permanent indicators shall show the direction of rotation of the impeller. Casings shall have access panels incorporating air seals to facilitate cleaning and maintenance of the impeller.

The fan outlet shall be flanged and drilled to suit connections to the ductwork system flexible connections.

Unless otherwise stated impellers shall be constructed of mild steel, aluminium or plastic and protected against corrosion. Impellers shall be keyed to the driving shaft or fixed with tapered bush fittings.

Each fan impeller shall be supported by an individual bearing system. Bearings shall be ball or roller type and shall be self-aligning. Indirectly driven fans shall be provided with pedestals incorporating two bearings. Bearings on the non-driven side of the fan shall be provided with a scroll stiffening framework supported from the fan base to maintain bearing position and alignment.

The impeller shaft shall be of solid mild steel, protected against corrosion, or stainless steel adequately sized such that its first critical speed is not reached before the design fan speed is obtained.

2.5.6. Roof Extract Fans

Roof extracts units shall be curb mounted vertical discharge propeller or aerofoil driven type and shall be robust in manufacture. They shall be suitable for mounting on a pitch roof and the design of the fan must incorporate a base that can be fitted over a weathering curb. The Contractor shall be responsible for agreeing and checking the weathering and detailing of the builder's work curb.

Cowls and bases shall be manufactured from GRP or aluminium and which are resistant to the weather and solar radiation, and appropriate to the location of the fan. The unit casing shall incorporate supports for the fan motor and impeller with integral anti-vibration mountings.

Casings shall be complete, with integral weatherproofing provisions suitable for direct fixing to the building structure, in accordance with the manufacturer's instructions.

Adequate access to electrical terminals and lubrication points shall be provided by means of either hinged cowls or access panels. A sealed electrical terminal block shall be provided.

The roof unit shall be finished to an approved colour.

Back-draught dampers and/or fire release dampers shall be provided where indicated.

Bird guards of not greater than 25 mm mesh shall be provided as an integral part of the unit.

An inlet attenuator shall be provided as indicated.

Impellers shall be multi-bladed steel, aluminium or plastic on a steel hub and shall be directly connected to the motor. Motors shall be pre-wired to the external electrical terminal box through weatherproof flexible conduit all rated at a minimum of IP55.

2.6. Smoke Clearance Fans / Make up air Fan

2.6.1. Fan Group for Fire Smoke Filter Pressurization

The fire smoke filters must be kept under pressure with fan, capable of meeting the technical/performance requirements of UNI EN 12101-13 and the specifications of the pump group.

It must be provided for:

- MANUAL ACTIVATION: machine always in operation 24H/24H with a duration of over 48,000 hours;
- AUTOMATIC ACTIVATION: machine in standby and activation via consent from the existing detection centre, under-glass button, or remote signal.

This system must be complete with: Control and command panel for the power supply group, to be placed in the fire pressurization room, consisting of:

- ON/RESET selector and MANUAL/AUTOMATIC selector on the front panel;
- BCS board for power supply and alarm management output;
- MASTER board for separate management of events that caused the alarm: management of electromagnets, signalling sirens, programmable alarm in positive and negative safety,
- groups of exchange contacts for alarm management, fault output, and remote anomaly reporting, AUTOTEST function, buffer accumulator.

- Provision for interfacing with existing centralized fire detection systems;
- 230/15-22-28-31V transformer provided for continuous 24h/24h expeller management.

Intake fan to be placed inside the pressurization room with the following characteristics:

- Brushless type suction group or similar in low voltage provided for continuous operation 24h/24h over 48,000 hours;
- Lead accumulators with autonomy over 120 minutes;
- Printed circuit board for event management, system control, general fault signalling, accumulator faults, and fan lock,
- Fan activation and protection with OMNIFET technology;
- Fan speed programming;
- Programmable RESET and AUTOTEST function;

Fire pressurization room (safe area), consisting of a metal container in which are assembled:

- Low voltage DC suction group Brushless 24 Volt with expected duration for continuous operation 24/24 hours = 48,000 hours (approx. 5 years)
- 2 sealed lead accumulators 12 V-26A sized to ensure system autonomy of over 120 minutes, even in the absence of mains power.
- Printed circuit board necessary to implement the system logic, interfaced with the main controller (event management and system control) and on which are located:
- Fault signalling circuit including lack of power from the main controller, accumulator inefficiency, and fan failure;
- Fan activation and protection using OMNIFET technology;
- Fan speed programming based on the pressure and air quantity required (only for BRUSHLESS UNI models);
- Connection terminals for connections to release buttons, various remote signals;
- Programmable auto test function; with a programmable periodicity, it performs an alarm simulation with battery-only operation to test its efficiency;
- The reset of any fault signal can be programmed to occur either on the fan board or on the main controller board.

Primary Activation Exclusively Automatic Expected fan motor duration 4000 hours (over 5 months).
Pressurization system to be placed inside the filter itself (safe area), consisting of a container in which are assembled:

Low voltage DC suction group with an expected fan motor duration of approximately 4000 hours, technical characteristics like BRUSHLESS UNI.
Control and command group, to be placed inside the fire pressurization room, consisting of:
Steel sheet container with fins, complete with front panel with:

- LEDs to display all information from the control unit;
- Keyed ON/RESET selector;
- Keyed MANUAL/AUTOMATIC selector.

Inside the container are installed:
A) Printed circuit board complete with control logic for managing all functions such as:

- Fan management following consent from the smoke detection system or lack of connection with the unit or manual command;

- Management of accessory devices such as electromagnets, signaling sirens to be connected to the power supply board with protection via fuses and polyswitch, with programming of the activation of these outputs depending on the input that generated the alarm;
- Programmable alarm management in positive or normal safety;
- Presence of three groups of exchange contacts for alarm management (remote signaling activations, etc.);
- Management of room pressurization even in the absence of mains power until the accumulators are exhausted;
- Complete interfacing with existing centralized fire detection systems;
- Fault output via signal relay to remote an anomaly of the main control unit.

B) The main controller board has four independent inputs to separately manage events that can cause an alarm, such as:

- Timed activation input of NC type with adjustable delay from 05 seconds to 120 seconds, suitable for intervening as a result of consents received from proximity sensors (state sensors installed between the door leaf and frame to detect imperfect closure situations) to initiate a pre-alarm sound, alarms, emergency lights, illuminated signs, telephone dialer, various types of remote signaling;
- Input for balanced smoke sensor that manages up to 5 detectors, timed with adjustable delay from 02 seconds to 120 seconds, suitable for intervening as a result of consent received from RADAR/INFRARED barrier at the passage of people, to be installed about 2 meters in front of the protected door to allow pressurization of the filter before opening the door;
- Instant activation input of NC type for connecting under-glass emergency buttons.

C) Power supply complete with 230/15-22-28-31V transformer with the function of powering the fan under normal conditions and maintaining the charge of the unit and main controlle unit batteries;

D) 12 V 2.2Ah buffer accumulator;

Accompanying Certifications

Declaration of supply;

Copy of the certificate relating to the testing and quality of the system provided by us and its compliance with the technical performance characteristics in accordance with the decree of 30/11/83;

Personalized copy of the certificate relating to suction ducts attesting to a fire resistance of REI 120';

Technical pre-dimensioning report carried out based on the preliminary project and the data provided by the customer, all in accordance with UNI EN 12101:6-2005 standards and the decree of 30/11/83, drawn up on plain paper and signed by a qualified technician on forms as per the decree of 4/5/98

Sample declaration of conformity of installation to the methods followed during certification

Declaration of origin (dich. imp. 2008 – dich. riv 2004)

According to UNI 11224:2007 standards, proper preventive maintenance is necessary to ensure the correct functioning of the equipment, aimed at reducing the probability of failure and the degradation of the components that make up the system.

These checks are recommended to be carried out at regular quarterly intervals, with a maximum frequency of every 6 months, as provided by UNI 11224:2007 standards and the procedures outlined in the user and installation manual.

Corrective maintenance must also be implemented following a failure caused by any reason or the system's intervention for alarm cycles exceeding two hours. The power supply to the ventilation unit must be guaranteed for at least two hours even in the event of a power outage due to a fire emergency.

2.6.2. Mechanical Smoke Extraction Systems (SFM)

Control and Command System of the SFM according to UNI 9494-2:2017 Appendix H

The smoke management system will be made according to the UNI 9494-2 Appendix H standard and it was designed by considering manual activation by fireman or fire brigade operator, after the people are egressed from the building.

2.6.3. Exhaust axial fan for SFM system

Axial fan for smoke control compliant with class A7.6 of the annex to the D.M. 16/02/2007, compliant with table S.2-38 of the D.M. 18/10/2019, and provided with CE marking according to UNI EN 12101-3:2015 "Smoke and heat control systems - Specifications for powered smoke and heat exhaust ventilators" for operation at 400°C for 2 hours in a fire emergency. Classified according to chapter 7.5 of UNI EN 13501-4:2016 "Fire classification of construction products and building elements - Part 4: Classification based on the results of fire resistance tests of components of smoke control systems.

Classification: F400 120

CE conformity mark.

Installable inside or outside the fire compartment.

Impeller:

- Adjustable blades allow flexible and precise selection of the desired operating point while maintaining high efficiency. The blade angle is pre-set at the factory.
- Impellers are made with airfoil blades in cast aluminum alloy.
- Dynamically balanced impeller according to ISO 21940-11 and ISO 14694, quality G6.3.
- Permanent indicators to show the direction of impeller rotation.

Casing:

- Hot-dip galvanized steel casing according to ISO 1461.
- Pre-drilled flanges according to Eurovent 1/2 on both sides providing additional stability.
- Pre-wired terminal box brought outside the casing with IP65 protection rating (IEC 60034-5) for easier installation.
- PV version: Includes a guide vane stage bolted to the casing that increases the pressure and efficiency of the fan.

Motor:

- Motor for operation at 400°/120min and 55°C continuously.
- High-efficiency three-phase asynchronous motor with squirrel-cage rotor, placed within the airflow.
- Motor protection class IP55 (IEC 60034-5), insulation class H.
- Motors can be equipped with PTC thermistors for motor protection (on request).
- Single and double speed motors available.
- Speed adjustable via inverter, operation allowed up to 10Hz

2.6.4. Boxed Centrifugal Exhaust Fans for SFM Systems

Soundproof Plug Fan for Smoke Control compliant with class A7.6 of the annex to D.M. 16/02/2007, compliant with table S.2-38 of D.M. 18/10/2019, and provided with CE marking according to UNI EN 12101-3:2015 "Smoke and heat control systems - Specifications for powered smoke and heat exhaust ventilators" for operation at 400°C for 2 hours in a fire emergency. Classified according to chapter 7.5 of UNI EN 13501-4:2016 "Fire classification of construction products and building elements - Part 4: Classification based on the results of fire resistance tests of components of smoke control systems." Having the following characteristics:

- 400°C/120 min (F400)
- Insulated casing
- Low noise level
- Permanent indicators to show the direction of impeller rotation.

The fan features a backward-curved impeller made of galvanized steel. The casing consists of a frame made of steel profiles, 4 double-walled panels in galvanized steel, with an insulating layer of 20 mm thick mineral wool. The suction side of the fan is equipped with a nozzle complete with a circular connection with a rubber sealing gasket. The air outlet panel, which can be easily changed on-site from inline direction to side or top outlet direction, is equipped with a circular connection with the same diameter as the suction side connection. High-temperature motor classified F400/120 min., available in single or dual-speed versions.

2.6.5. Axial Supply Fans for SFM Systems

Axial fans for continuous operation in the temperature range -20°C/55°C with CE conformity marking.

Impeller:

- The adjustable blades allow for flexible and precise selection of the desired operating point while maintaining high efficiency. The blade angle is pre-set at the factory.
- The impellers are constructed with profiled blades made of die-cast aluminum alloy.
- The impeller is dynamically balanced according to ISO 21940-11 and ISO 14694, quality G6.3.
- Permanent indicators to show the direction of rotation of the impeller.

Casing:

- Casing made of hot-dip galvanized steel according to ISO 1461.
- Pre-drilled flanges according to Eurovent 1/2 on both sides providing additional stability.
- Pre-wired terminal box externally mounted on the casing with protection class IP65 (IEC 60034-5) for easier installation.
- PV version: Includes the stator guide vane stage bolted to the casing, which increases the pressure and efficiency of the fan.

Motor:

- Motor for operation at 400°C/120min and 55°C continuously.
- High-efficiency three-phase asynchronous motor with squirrel-cage rotor, placed within the airflow.
- Motor protection class IP55 (IEC 60034-5), insulation class H.
- Motors can be equipped with PTC thermistors for motor protection (on request).
- Single and double speed motors available.
- Speed adjustable via inverter, operation allowed up to 10Hz.

2.6.6. Soundproof SFM Plug Fan with the following features:

Soundproof Plug Fan with the following features:

- Controllable speed
- Integrated thermal contacts
- Insulated casing
- Reconfigurable air direction thanks to removable panels
- Low noise level
- Permanent indicators to show the direction of rotation of the impeller

The fan features a backward-curved blade impeller made of galvanized steel. The casing consists of a frame made of steel profiles, four double-walled panels in galvanized steel, with an insulating layer of 20 mm thick mineral wool. The suction side of the fan is equipped with a nozzle complete with a circular connection and rubber sealing gasket. The air outlet panel, which can be easily changed on-site from inline direction to side or top discharge, is equipped with a circular connection with the same diameter as the suction side connection.

2.6.7. Control Panel for Smoke and Heat Control Systems

"Automation Level" Control Panel for Smoke and Heat Control Systems and Fire Damper Systems, capable of switching the system from a standby state to a fire state based on programmed scenarios, controlling, operating, and signaling the status of all active elements of the system. Advanced real-time testing function and periodic maintenance of each system component according to current regulations.

Remote access and control of the unit.

Graphical interface with touch screen for programming and controlling up to 6 fire scenarios, 240 smoke/fire control dampers (up to 120 field modules), and a maximum of 5 programmable outputs simultaneously.
Plug & play interface system for connecting all smoke/fire control dampers in the system via specific field modules.
Integrable with any detection system and/or any building automation system (Building Management System).
Remote programming and loading of the operation matrix via Cloud.

The panel can be expanded via input/output expansion modules to support up to 60 fire scenarios and 35 programmable outputs. Manufactured in compliance with Directive 2006/95/EC and 2004/108/EC and the safety and electromagnetic compatibility standards IEC 60730-1 and EN 60730-1. Control panel provided with a declaration of conformity to UNI 9494-2:2017 and UNI ISO 21927-9:2021.

Universal I/O expansion module capable of providing an additional 8 inputs and 10 outputs on the control panel. Universal input/output expansion module capable of interfacing with any BACnet or Modbus network, providing additional inputs and outputs that are monitorable and controllable.

Universal "Field Level" Field Module for Smoke and Heat Control Systems and Fire Damper Systems.

Field module capable of controlling, operating, and signaling the status of smoke control dampers and/or fire dampers.
Ability to monitor damper operation via integrated display and perform functional tests directly on the damper at any time using the test function.
Logical communication via Modbus, BACnet, or analog protocol, interfacing with control panels.
Capable of operating independently via digital input signal from the detection system or smoke detectors. Integrable with any detection system and/or building automation system (Building Management System).

Structure Module with Repeater Function for Creating a Ring Bus System from a Standard Bus System

- Interfacing with SMMC line control panels.
- 3-channel hub driver for RS-485 networks.
- Ring structure module to change a bus type from standard to star or ring.
- Channels constantly monitored for potential short circuits.
- Ring mode for system protection in case of cable interruption.
- Galvanic isolation for maximum safety in case of network disturbances.
- Can be used to extend existing RS-485 networks.
- Maximum cable length for each channel is 1,200 m.
- When used as a hub, it acts as a star point or can enable the creation of a ring RS-485 line.
- Channel 1 serves as the input (from the SMMC control panel), channels 2 and 3 are the start and end points of the ring.
- Anomaly indications are visually saved and signaled via a clean collective alarm contact. The test button allows verification of the bus line integrity even without communication.

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Grilles Diffusers and Louvres
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

Document: A07 ES E CM 01-

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1. INTRODUCTION

This specification details the requirements for vents/grilles/diffusers.

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications..

2. CONSTRUCTION FEATURES

2.1. Supply air grille

2.1.1. Single Row Blade Grillesa singolo ordine di alette

They must have a series of adjustable blades to control the diffusion and/or direction of the air. The blades should be horizontal or vertical depending on the application. Unless otherwise specified, each grille must be equipped with an air flow regulator.

2.1.2. Double Row Blade Grilles

They must have two sets of adjustable blades to control the diffusion and/or direction of the air. One set of blades should be horizontal, the other should be vertical. Unless otherwise specified, each grille must be equipped with an air flow regulator.

2.1.3. Grid and Square Mesh Grilles

They are to be used only for extraction when a large extraction surface is needed. These grilles are not adjustable but have fixed elements. Unless otherwise specified, each grille must be equipped with an air flow regulator.

2.2. Return air grille

2.2.1. Single Deflection Grilles

As described for supply grilles.

2.2.2. Double Deflection Grilles

As described for supply grilles.

2.2.3. Griglie Grid and Square Mesh Grilles

As described for supply grilles.

2.2.4. Extraction Valves

Dimensions and specifications as indicated in the diagrams. They must be made of plastic or aluminum as specified and designed for easy cleaning.

Volume control is achieved by adjusting the inner core.

2.3. Transfer Grilles

2.3.1. Non-vision and Transfer Grilles

They limit the view between two areas while allowing ventilation transfer.

At a minimum, they must have a core of overlapping "V"-shaped blades. Light-blocking grilles must have complex, matte black cores designed to prevent light transmission between areas such as dark rooms and adjacent spaces.

2.3.2. Interior Transfer Grilles

For the passage of air between two adjacent rooms. They will be made entirely of hot-dip galvanized steel in RAL color as specified by the DL.

They will be positioned as per the graphic documents.

2.3.3. Soundproof Transfer Grilles

Grille with soundproof protection in galvanized steel or aluminum with a sound-absorbing element made of mineral wool protected by micro-perforated sheet metal, available in single or double versions complete with welded mesh in galvanized steel, with the following characteristics:

- Acoustic tests according to ISO EN 11691
- Maximum pressure drop 50 Pa
- Maximum frontal velocity 3 m/s

2.4. Air Intake or Exhaust Grilles

2.4.1. Air Intake or Exhaust Grille

The external air intake and exhaust grilles will be installed outside.

They must be made of galvanized steel, equipped with a galvanized steel subframe to be embedded for installation on masonry, with the following characteristics:

- Front surface with blades inclined at 45 degrees, with a 50 mm pitch, shaped to prevent rain ingress, the bottom blade will be a drip-proof tile
- Anti-bird mesh in galvanized steel
- Fixing with visible stainless steel screws attached to the subframe.

The color of the intake or exhaust grilles will be defined by the RAL chosen by the COW.

2.4.2. Soundproof Exhaust or Air Intake Grilles

The soundproof external air intake and exhaust grilles will be installed outside.

They must be made of galvanized steel, equipped with a galvanized steel subframe to be embedded for installation on masonry, with the following characteristics:

- Front surface with blades inclined at 45 degrees, with a 50 mm pitch, shaped to prevent rain ingress, the bottom blade will be a drip-proof tile
- Anti-bird mesh in galvanized steel
- Fixing with visible stainless steel screws attached to the subframe
- Sound-absorbing material in rock wool 55 kg/m³ protected with black glass veil and micro-perforated mesh
- Acoustic tests according to ISO EN 11691
- Maximum pressure drop 50 Pa
- Maximum frontal velocity 3 m/s

and must ensure damping as per the technical data sheets and acoustic report.

The color of the intake or exhaust grilles will be defined by the RAL chosen by the COW.

2.5. Supply and Return Diffusers

The diffusers must be positioned as indicated in the drawings.

Supply air diffusers must have adjustable blades so that the air distribution can be regulated.

Return air diffusers must have fixed elements unless it is necessary to match them aesthetically with the supply grilles.

Specific diffusers must be used as indicated below.

2.5.1. Linear slot diffusers

Linear slot diffusers will be constructed with extruded aluminum bodies unless otherwise specified.

Linear diffusers can either be of the fixed blade type or must include means to independently adjust the direction of the air jets, as indicated. The method for controlling the air volume flow rate must be as specified.

When linear diffusers are mounted in a continuous line, devices must be provided to ensure inline installation between adjacent diffusers, and each diffuser must be equipped with means to ensure uniform air flow distribution along the diffuser.

Hidden alignment strips must be provided to ensure the support and correct alignment of the diffusers. Where diffusers are supplied in sections, the individual sections must be selected so that their dimensions are as regular as possible without the use of shorter pieces for closure.

The active sections of the linear diffusers must be equipped with plenums manufactured by the diffuser manufacturer, sized according to the diffuser flow rates. The construction of the plenums must be as indicated in the relevant paragraph.

Ceiling-mounted linear diffusers must be mounted in the ceiling grid with the connection chamber properly fixed to the diffuser and sealed against air leaks.

The contractor must pay particular attention to ensuring that the final appearance of the linear slot diffusers meets the architect's expectations. The contractor must discuss all aspects with the design team, the general contractor, and the ceiling contractor to ensure these expectations are met.

All necessary support and fixing brackets for the diffuser and plenum must be provided for installation.

Dummy sections of the linear diffuser must be equipped with closure plates, unless such plates are to be omitted to provide a return air path.

The installer will be responsible for taking all necessary site measurements for the layout and installation of the diffusers. This will include all involved angles.

Unless otherwise specified, each diffuser must be equipped with an air flow regulator.

2.5.2. Square and Circular Diffusers

Diffusers must be selected to provide adequate air distribution and mixing with room air outside the occupied space. Deflectors must be provided as needed or as indicated to avoid local obstructions.

Unless otherwise specified, each diffuser must be equipped with an air flow regulator and a means to modify the air flow pattern. All regulators must be adjustable from the front of the diffuser.

Diffusers with ducted connections must be supplied with plenums selected and manufactured by the diffuser manufacturer to fit the diffuser outlet. The construction must be as indicated in these specifications. Each plenum must be sealed to the back of the diffusers.

When a diffuser is connected directly to a duct with a straight length of less than two equivalent diameters, an equalizing deflector must be used.

Circular diffusers with adjustable air flow must have the adjustment cone fixed to a screwed pin with upper and lower stop constraints or another approved method.

2.5.3. Helical Diffusers

These diffusers are designed to impart a radial action to the incoming supply air to induce high mixing ratios. Normally, the device must be designed for horizontal discharge unless otherwise specified.

Helical flow diffusers must be able to adjust the volume from the central plate without disassembling the diffuser.

2.5.4. Multi-Nozzle Diffuser

Multi-nozzle diffuser with individually adjustable nozzles for long air throws with low noise levels and high induction ratios. The nozzles are adjustable by 30° in any direction without changing the pressure drop.

Nozzles made of plastic, front plate in galvanized steel, and frame in painted extruded aluminum for ceiling mounting with clips or screws (on request).

Accessories:

- Sliding damper in Sendzimir galvanized steel, operable from the front of the diffuser
- Insulated plenum

2.5.5. Deep Throw Nozzle Diffuser

For wall or ceiling mounting, it must be usable for both heating and cooling with temperature differentials from -14K to +25K.

If it becomes necessary to shorten the throw, for example, if mounted on the ceiling with a need for vertical throw, the diffuser must be equipped with a special deflector disc; the deflector disc significantly increases the already high induction of the nozzle, consequently reducing the final air velocity in the occupied zone.

For wall installation, the diffuser must be equipped with an adjustable body (variable inclination angle depending on the size, from 20° to 30°) manually or via an electric servomotor as specified in the project.

2.5.6. Impulse Diffusers for Supply and Return

Ceiling diffuser for supply or return.

Installation height between 2.6 and 4 meters.

2.5.7. Floor Diffusers for Supply and Return Air PA

Linear supply and return air grille for floor mounting.

It must be supplied complete with a sliding calibration damper and a subframe for fixing to the duct or for possible embedding.

The grille will be made of anodized aluminum while the calibration damper and the subframe will be made of galvanized steel sheet.

The grille will be fixed to the subframe using hidden clips or chrome-plated self-tapping screws.

The calibration damper must be easily adjustable from the outside of the grille.

It must be supplied complete with a plenum (insulated for supply).

In the case of return air grilles for FC, the grille must be complete with a plenum with filter holder and filter.

2.6. Plenum

The plenums must be supplied as indicated and must have the same specifications as the connecting ducts and be equipped with circular inlets with flexible connections and butterfly-type balancing dampers, unless otherwise specified.

All plenums must be independently supported from both the ductwork and the grille or diffuser. The preferred method of fixing is by vertical adjustment rods fixed to the slab and permanent tabs on the plenum with locking nuts.

If connected to insulated ductwork, the plenum must be insulated to the same standard as the connecting duct.

The outlets from the plenums must be circular or rectangular to fit the diffuser connection.

The dimensions of the plenum must be those recommended by the diffuser manufacturers and must be adequately sized to ensure the correct performance of the diffuser in terms of noise level, throw, and pressure drop.

Where appropriate, the plenums must be equipped with perforated galvanized steel plates to achieve even air distribution and uniform pressure drop across the face of the connecting grilles or diffusers.

If the plenums are equipped with opposed blade dampers, dampers on the served diffuser connection will not be necessary.

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Pipework, fittings and ancillaries
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

Document: A08 ES E CM 01-

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1. INTRODUCTION

This specification details the requirements for pipings, fittings and ancillaries.

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications

2. CONSTRUCTION FEATURES

2.1. Pipework

2.1.1. Metallic pipework materials

Unless specified within the project documents pipework materials shall be priced and installed on the project as detailed within the pipework materials tables within this specification. Any 'acceptable' pipework materials listed within the tables may be offered to the engineer as a value engineering option.

This shall be at the discretion of the contractor but materials shall not be ordered or installed on-site until approval is given by the engineer.

All valves or pipes for drinking water must have specific certifications approved by Italian regulations.

2.1.1.1. Steel tubes

Seamless pipes, in non-alloy steel, according to UNI 10255 medium or heavy series (pipes up to 150mm in diameter);
Commercial smooth steel boiler pipes, seamless, according to UNI 7287;
Seamless pipes, in non-alloy steel, according to UNI EN 10224 series B and C;
Seamless pipes, in Fe 45-1 steel, according to UNI EN 10216-1;

For all pipes, operating conditions based on temperature and operating pressure, according to UNI 1284.

Technical delivery conditions with minimum wall thickness as listed in the following table.

Nominal diameter DN	External diameter mm *min*	Wall thickness mm	Conventional mass kg/m
10	17,2	1,8	0,684
15	21,3	2,0	0,952
20	26,9	2,0	1,23
25	33,7	2,3	1,78
32	42,4	2,6	2,55
40	48,3	2,6	2,93
50	60,3	2,9	4,11
65	76,1	2,9	5,24
80	88,9	3,2	6,76
100	114,3	3,6	9,83
125	139,7	4,0	13,4
150	168,3	4,5	18,2
200	219,1	6,3	33,1
250	273,0	6,3	41,4
300	323,9	7,1	55,5

Where galvanised pipework is specified, it shall be supplied as the standard manufacturer's protective finish by means of hot dip zinc coating to UNI EN 10255 non-alloy steel tubes suitable for welding, threading and incorporating EU directive (89/106/EEC) unless specifically specified as galvanised after manufacture (GAM).

Pipes for welding shall have plain or chamfered ends. Elsewhere ends shall be threaded in accordance with UNI EN 10226-1.

Threads shall be protected during transportation and storage by means of secure plastic caps.
Pipework shall be cut, where necessary, to leave the tube bore unobstructed and without deformation.

Fittings for steel pipework
For 50 mm diameter or less, screwed fittings for steel pipe shall be malleable cast iron complying with UNI EN 10242 Threaded pipe fittings in malleable cast iron.

For any pipe size greater than 50 mm, wrought steel threaded fittings shall comply with UNI EN 10241.

Fittings used on welded pipework shall be of the forged seamless pattern, manufactured from carbon steel and complying with UNI EN 10253-1.

Where fittings are used on galvanised pipework, the fittings shall also be galvanised.

2.1.1.2. Copper pipework

Copper tubes shall be seamless round pipes to comply with UNI EN 1057 Copper and copper alloys.
Seamless, round copper tubes for water and gas in sanitary and heating applications and UNI EN 12449 Copper and copper alloys.
Seamless, round tubes for general purposes, Annealed type in coils and raw in rods.
Diameters, thicknesses, and masses conform to series B (heavy).

The following grades shall be used
- R220 Soft – Used in concealed and buried applications.
- R250 Semi-hard – Used for most applications.

All copper tube delivered to site shall be certified and "Made in Italy" kite marked. Any tube found not complying with these requirements shall be removed and replaced at no charge to the contract.

Where predominantly steel pipework distribution systems are to be installed on chilled water or low temperature hot water heating systems, the use of copper tails shall be accepted, providing runs do not exceed 20 m and shall be restricted to a maximum pipe size of 22 mm diameter.

Pipework shall be cut, where necessary, to leave the tube bore unobstructed and without deformation. Copper tubes shall be cut with a tube cutter and reamed out to full bore at the cut end.

Fittings for copper pipework
Copper fittings shall comply with UNI EN 1254 Copper and copper alloys. Plumbing fittings, Parts 1, 2, 3, 4, 5, 6, & 8. End feed capillary fittings will not be permitted fittings for copper pipes shall be of a non-dezincifiable pattern.

Connections to screwed valves, fittings and equipment shall be bronze or gunmetal with threads complying with UNI EN 10226-1.

Copper bends made on site shall be cold drawn by a hydraulic bending machine. The radius shall be not less than three times the pipe diameter. Bends and sets shall be made without deformation of the internal tube.

2.1.1.3. Stainless Steel Pipework

Standard execution for pressure networks

Seamless drawn pipes, in AISI 316 S stainless steel, electric-welded, solution-annealed, ISO series, inspection and testing according to UNI EN 10216-5.

Standard execution for drainage and ventilation networks

Welded pipes in AISI 304 stainless steel, 1 mm thickness up to DN 110, 1.5 mm for larger diameters.

2.1.1.4. Lead pipework

No product containing lead or lead alloy shall be used in the works, except where clearly stated within the project documents.

2.1.1.5. Finishes

Galvanized steel pipes with hot-dip galvanizing according to UNI EN 10240

Buried pipes protected with heavy-duty coating consisting of:

- Base with bitumen film,
- Protective layer with bituminous mixture,
- First reinforcement layer with glass felt impregnated with bituminous mixture,
- Second reinforcement layer with glass fabric impregnated with bituminous mixture,
- Surface finish with calcium hydrate film.

2.1.1.6. Type of execution

Except where explicitly indicated in the project documents, and with respect to what is defined in paragraph 2.5.1, refer to the table below

Circuit	dimension	Material	Ref. UNI	Series	Type of execution
Chilled water	Up to ∅1 1/2" from DN 50 to DN 600	steel "	8863 7287	medium	black black
Hot water-heating	Up to ∅1 1/2" from DN 50 to DN 600	" "	8863 7287	medium	black black
Water for condensation	Up to ∅1 1/2" from DN 50 to DN 600	" "	8863 7287	medium	black black
Potable water PN 10	Up to ∅4" from DN 125	" "	8863 6363	medium B	galvanized galvanized
Potable water PN 16	Up to ∅4" from DN 125	" "	8863 6363	medium C	galvanized galvanized
Well water PN 10	Up to ∅4" from DN 125	" "	8863 6363	medium B	galvanized galvanized
Well water PN 16	Up to ∅4" from DN 125	" "	8863 6363	medium C	galvanized galvanized
Water for hydrants	Up to ∅4" from DN 125	" "	8863 6363	medium C	galvanized galvanized

Water for sprinklers	Up to ∅4"	"	8863	medium	galvanized
	from DN 125	"	6363	C	galvanized
Fuel gas	Up to ∅4"	"	8863	medium	galvanized
	from DN 125	"	6363	C	galvanized
Compressed air	Up to ∅4"	"	8863	medium	galvanized
Extinguishing gas	all diam.	"	7088	medium	galvanized

2.1.1.7. Methods of Jointing

Joints

Pipework shall be jointed as shown in the table below, unless otherwise indicated in the specifications or project documents.

The use of pipe and fittings that require a torch flame to make a joint, should be avoided. In all cases approval must be obtained, in writing, from the engineer, whose decision on the suitability shall be final and binding.

The contractor shall be responsible for ensuring that each fitting is checked to ensure that the joint is properly made, in accordance with the manufacturer's instructions.

All couplings shall be fitted strictly in accordance with the manufacturers' recommendations. Attention shall be given to cleanliness and lack of distortion of the tube and fitting and to ensuring full insertion depth in fitting.

All tube ends shall be thoroughly cleaned and de-burred prior to making any joint.

Whichever system of jointing is used, it is essential that facilities are provided at each item of plant or equipment is provided with adequate means of removing it without recourse to dismantling the pipework system.

All fittings and jointing materials used on potable water shall comply to Decreto n° 6 aprile 2004, n. 174 "Regolamento concernente i materiali e gli oggetti che possono essere utilizzati negli impianti fissi di captazione, trattamento, adduzione e distribuzione delle acque destinate al consumo umano".

Material to be connected	Type of connections	Jointing Material
Copper to Copper pipe or fitting	Capillary joint soldered	Flux and solder, Jointing compound to local Authority's approval
Copper to Copper fitting.	Compression fitting. Push-fit	
Welded copper to copper pipe of fitting	Bronze welded	Borax based flux, bronze welding rod, hard solder.
Copper to flanges on fitting	Flanged	Bi-metal Flanges, welding rod, joint rings, nuts, bolts and washers.
Copper union tap connector	Screwed	Fibre Washer
Connections to tanks or cisterns smaller sizes	Screwed with backnut	Plastic washers
Connections to tanks	Flanged	Nuts, bolts and washers
Connections to tanks	Screwed	PTF Tape
MDPE to MDPE pipe or fitting	Durafuse system or equivalent	
MDPE to copper	As manufactured by Messrs Philmac	
Polybutylene	Hepworth HEP20	Push -fit fittings

Material to be connected	Type of connections	Jointing Material
Polybutylene	Instaflex fusion	Fusion fittings
PVC-C	Rriatherm adhesive joints	Fittings for adhesive joints

Screwed Joints (Non-Potable Services)
Steel pipe having screwed joints shall be carefully reamed out before the plain end is screwed.

Screwed joints shall be to UNI EN 10226-1, UNI EN 10226-2 and UNI EN 10226-3. Parallel external (male) threads on pressure gauge cocks and pressure gauges shall not be used without approval of the engineer and then only with the use of suitable washers or grommets compressed between the end of the parallel male thread pipe or connector and a shoulder at the bottom of the parallel female thread.

When making a joint the screw thread shall be wrapped with PTFE tape. The joint shall be arranged so that on completion two or three threads are left showing.

Should a screwed joint prove defective under subsequent test, the section of pipework in question shall be removed and made good. Caulking will not be permitted.

Screwed Joints (Potable Water Services)
Screwed joints on pipework threaded in accordance with UNI EN 10226-1 Pipe threads where pressure tight joints are made on the threads shall be jointed by means of approved compounds and sealants to UNI EN 751-2 Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water. Jointing compound likely to come into contact with potable water shall comply with the relevant requirements of Decreto n° 6 aprile 2004, n. 174 "Regolamento concernente i materiali e gli oggetti che possono essere utilizzati negli impianti fissi di captazione, trattamento, adduzione e distribuzione delle acque destinate al consumo umano".

Excess jointing material shall be kept to a minimum and any excess cleaned off and removed.
The amount of hemp and paste used shall be kept to a minimum and excess removed.
Where excessive use of hemp is observed the length of pipe and fittings involved shall be replaced with new materials.

Flanged Joints
Steel pipes having flanged joints to UNI EN 1092-1 shall be prepared to suit method of attachment required.

Pipes not galvanised shall be provided with flanges screwed or welded on for nominal bores of 50 mm and below and flanges welded on for larger sizes. Galvanised pipes shall be provided with galvanised flanges screwed for nominal bore of 100 mm and below and with flanges welded on prior to galvanising the pipe for larger sizes or, where specified for all sizes, galvanised after manufacture.

Welded flanges shall be of the slip-on pattern with neck machined on face secured by welding both the neck and bore of the flange to the pipe, with the tube finishing 3 mm inside the bore. Care shall be taken not to distort the machined face.

Flanges shall incorporate bolt holes drilled not punched.

Flanges shall be joined with 1.6 mm Klingerite gaskets, nuts, bolts and washers of hexagon type protected to be free from rusting throughout. Gaskets to be type A for full-faced flanged appliances and type B for raised face flanges.

Bolts for UNI EN 1092-1 flanges shall conform to EN ISO 4016 "Hexagon head bolts - Product grade C" and EN ISO 4018 "Hexagon head screws - Product grade C", 400 N/m2 minimum tensile strength. The gaskets will have graphite finish and

no jointing paste will be used. All flange bolts be complete with a washer beneath the head and the nut with the bolts protruding two clear threads of the nut.

All flanges shall have zinc-plated nuts, bolts and washers.

Welded Joints

Welded joints shall be provided where indicated in the tables and generally on all mild steel pipework of 65 mm nominal bore and above and on all concealed and inaccessible pipework.

Welds shall be:

- A penetration weld finished off with a fillet weld of ample dimensions.
- Of good clean metal, free from slag inclusion and porosity.
- Of even thickness and regular contour.
- Well fused with the parent material.
- Free from serious undercutting of overlapping at the toes of the weld.
- Hammered and finished smooth.
- Of sufficient strength to withstand the stresses imposed by internal pressure, thermal expansion and the weight of pipe, fittings and insulation, etc.
- Wire brushed and visually inspected upon completion.
- Painted immediately after completion or inspection with zinc phosphate or anti-corrosion primer, unless the pipework is to be galvanised.
- Located not less than 600 mm from any anchor points.
- Oxy-acetylene welding shall not be used for steel pipework above 100 mm or on pipe flanges of any size.

Welding shall be carried out by arc welding or oxy-acetylene welding in compliance UNI EN ISO 15614.

Any weld which, in the opinion of the engineer, is unsatisfactory shall be cut out and replaced.

Where a weld has been cut out and it is not practicable to draw up the pipe ends to make a new weld, a new section of pipework, not less than 1.2 m long, shall be inserted and butt-welded in.

Welder qualification

Only qualified welders shall be employed. Should the welds of any particular welder be consistently rejected after inspection, he shall be deemed unfit to continue welding pipework.

Each welder shall have passed within 12 months, the tests set out in UNI EN 287-1 Qualification test of welders and UNI EN ISO 9606 Qualification testing of welders, fusion steels and hold a current certificate, issued within 12 months, by one of the following authorities:

- Insurance Companies – Associated Offices Technical Committee.
- The National Joint Industrial Council.
- Local Approved Certification when outside the United Kingdom.

Weld identification

Each welder shall mark each completed production weld at the time of welding with a unique identification mark, which may be:

- A metal tag attached to the pipe.
- Stencilled adjacent to the weld.
- Stamped adjacent to the weld.
- The method of identification agreed with the engineer as set out in the main contract preliminaries.

Weld testing

Welds shall be subject to continuous regular inspection and testing, following UNI EN ISO 17635 Non-destructive testing of welds. General rules for metallic materials which shall comprise:

- Visual inspection to UNI EN ISO 17637 Non-destructive testing of welds. Visual testing of fusion-welded joints.
- Radiographic testing to UNI EN ISO 17636 Non-destructive testing of welds. Radiographic testing Parts 1 and 2.
- Ultrasonic testing to the standards defined in UNI EN ISO 17635.
- Penetrant testing to UNI EN ISO 3452-1 Non-destructive testing. Penetrant testing.

Other test methods must be advised to the engineer in writing before testing commences.

Welds for inspection and testing shall be selected at random by the engineer.

Each welder shall provide a test specimen, manufactured under working conditions and witnessed by the engineer, for each type of weld to the relevant standard.

Physical testing shall be applied to three of the first ten production welds made by each welder.

Should any weld be rejected or require rectification, then a further three welds, by the same operator, shall be selected for examination. In the event of further failure in these welds, all the welds performed by the particular operator may be liable to rejection by the engineer.

Physical testing shall comprise:

- The weld to be cut out for test purposes.
- The weld to be subject to visual examination and bend tests in accordance with the relevant standard.
- The weld to be re-made.

Alternatively, the welder may prepare a test specimen made up of two similar lengths of pipe welded in a position closely representative of the selected production weld and witnessed by the engineer.

Should more than 10% of those welds tested prove unsatisfactory, a further 5% of all welds shall be tested.

Radiographic testing shall be carried out by an independent approved firm holding current approved certificates issued by Lloyds, BOC, etc., who shall be employed by the contractor.

The contractor shall advise the engineer and obtain his approval of the proposed firm prior to work commencing.
Radiographing, in-situ, demanding areas to be cleared of personnel, shall be agreed with the Principal Contractor. Generally, where it is necessary to clear areas of personnel, these operations shall be undertaken outside normal site working hours to minimise the disruption of the flow of work.

The costs of carrying out these tests out-of-normal site working hours shall be included for in the tender sum.

The radiograph shall be identified with a permanent record number of each weld and copies given to the engineer for retention.
Records of the tests and the results shall be issued direct to the engineer with a copy to the contractor.

Welding restriction & compliance
No welding shall be carried out:
- When the surface of materials are wet.
- In rain or high winds.
- When the temperature of the parent metal is 4°C or below.
- On galvanised pipework.

The contractor shall:
- Provide all necessary plant and equipment to carry out welding in accordance with this Specification.
- Make provision for adequate power supply for welding.
- Provide a copy of the current certificates for each welder he proposes to employ prior to that welder commencing work.
- Provide a minimum of two days' notice before he intends to employ a welder to allow the specified tests to be carried out.
- Provide an up-to-date schedule of welders and their approved identification mark.
- Provide adequate staging, protection from weather and screening to enable welding to be properly performed without hazard to personnel or finished works.
- Provide adequate supervision to ensure that all welding is carried out in accordance with this Specification.
- Allow for all costs associated with testing and any remedial works.
- Allow for protection of persons and materials, including fire protection and ventilation.
- Allow, within the construction programme, for the tests to be undertaken without affecting stage or final completion dates.
- Be responsible for any consequential costs related to delay to other trades resulting from a requirement to undertake remedial works.

Press fit systems
Where identified within the technical schedules the use of a "press fit" system shall be permitted within the temperature and pressure constraints of the services specified. The working pressure of fittings shall not be less than 16 bar. The contractor must ensure the grade of seal ring material meets the requirements of the fluid or gas which the pipe is carrying.

All press fit joints shall be formed using the appropriate manufacturer's jointing tool which shall be properly maintained. All operatives shall be trained in its use and it shall be used in accordance with the manufacturer's instructions.

Attention is drawn to the operators safety requirements for use of specialist tools required for forming the "press fit" joints; in particular the space necessary for this safe use of the electric jointing tools. The contractor must ensure the correct tools, pipe and fittings are all sourced from the same company.

The choice of piping material shall be selected as appropriate for the service application and as detailed within the documents. The pipework shall be selected from:
- Copper or copper alloy.

The sealing rings or gaskets shall be either:

- Butyl rubber.
- Nitrite or acrylonitrile butadiene rubber.
- Fluoropolymer or fluoroelastomer.

Prior to placing orders, the contractor shall provide a technical submission confirming the products suitability in respect of:

- Maximum working temperature.
- Maximum working pressure.
- Fluid or gas to be transported.

Joints shall be made strictly in accordance with the manufacturer's application guide and attention is drawn to the following points:

- Checking alignment and correct insertion depth.
- Correct lubrication without over lubricating.
- Pipes to be jointed are correctly prepared and ends square and "burr" free.

Pipework systems shall be supported strictly in accordance with the manufacturer's guidance notes to avoid the stressing of joints and components.

Push fit systems

The system shall be installed as detailed within the documents and within the specified application, temperature and pressure range.

Fittings shall be drawn from the appropriate range to suit specified temperature and pressure conditions and compatible with the pipe specified. Joints shall be made strictly in accordance with the manufacturer's recommendations and using the appropriate push fit demounting tool approved by the tube system manufacturer.

The performance criteria listed within the Table below shall be used.

Temperature °C	Max Operating Pressure
0 - 30°C	16 bar (Gauge)
65°C	10 bar (Gauge)
95°C	6 bar (Gauge)

Note these conditions must not be exceeded when undertaking system testing procedures.

Prior to placing orders, the contractor shall provide a technical submission confirming product suitability.

Fixings and support centres shall be in accordance with the manufacturer's installation guidance notes and not exceed those specified within this specification.

Brazed Joints

Brazed joints shall be in accordance with UNI EN 14324 Brazing. Guidance on the application of brazed joints.

Couplings shall be used where joints are visible. Elsewhere they may be made by properly belling or swaging one pipe to allow insertion of the other. Brazed joints shall be made using filler rods and appropriate fluxes.

During all jointing operations using brazing fittings, the operative shall be accompanied by a competent assistant and suitable non-combustible mats shall be used to protect the building fabric and decoration. Every precaution shall be taken to prevent damage by scorching or fire. Portable fire extinguishers, in accordance with Health and Safety requirements, with a minimum of two, shall be provided in all areas where brazing is being carried out. Operatives shall be fully trained in the use of such appliances.

If specified within the project documents the following test regime shall be instigated. These shall be clearly defined and set out within the pipe schedules:

- Non-destructive testing shall be carried out on 5% of all joints. These shall be selected at random and independently checked by an approved testing authority. The test shall be undertaken in accordance with UNI EN 12799 Brazing. Non-destructive examination of brazed joints.
- Destructive testing shall be carried out on 2% of all joints. These shall be selected at random and independently checked by an approved testing authority. The tests shall be undertaken in accordance with UNI EN 12797 Brazing. Destructive tests of brazed joints.

Any joints found to be unsatisfactory shall be cut out and re-made.

The contractor shall allow for all costs associated with the cutting out, testing, re-making and non-destructive testing of joints if specified.

Capillary fittings

Le giunzioni capillari dovranno essere realizzate pulendo accuratamente i bicchieri dei raccordi e le estremità dei tubi e utilizzando un idoneo disossidante come di seguito descritto. I raccordi capillari dovranno avere anelli di saldatura integrati. Non sarà necessario aggiungere ulteriore materiale saldante al giunto e tutto il flusso in eccesso dovrà essere rimosso.

La saldatura per giunti capillari deve essere conforme alla norma UNI EN ISO 9453 Leghe per saldatura dolce. Composizioni chimiche e forme.

I raccordi capillari devono essere conformi alla norma UNI EN 1254-5 Rame e leghe di rame. Raccordi idraulici.

I giunti saldati devono essere realizzati utilizzando saldature senza piombo. Non sarà consentito l'uso eccessivo di flusso o flusso autopulente.

Durante tutte le operazioni di giunzione mediante capillare, l'operatore dovrà essere accompagnato da un assistente competente e dovranno essere utilizzati idonei tappetini non combustibili per proteggere il tessuto edilizio e la decorazione. Dovrà essere adottata ogni precauzione per evitare danni dovuti a bruciature o incendio. Estintori portatili, in conformità con i requisiti dell'Appaltatore principale, con un minimo di due, dovranno essere forniti in tutte le aree in cui viene eseguita la brasatura. Gli operatori dovranno essere pienamente addestrati all'uso di tali apparecchi.

Capillary joints shall be made by thoroughly cleaning sockets of fittings and ends of pipes and by using a suitable flux as described below. Capillary fittings shall have integral solder rings. No additional solder shall be added to the joint and all surplus flux shall be removed

Solder for capillary joints shall conform to UNI EN ISO 9453 Soft solder alloys. Chemical compositions and forms.

Capillary fittings shall comply with UNI EN 1254-5 Copper and copper alloys. Plumbing fittings.

Soldered joints shall be made using lead-free solders. Excessive use of flux or self-cleaning flux will not be permitted.

During all jointing operations using capillary, the operative shall be accompanied by a competent assistant and suitable non-combustible mats shall be used to protect the building fabric and decoration. Every precaution shall be taken to prevent damage by scorching or fire. Portable fire extinguishers, in accordance with the Principal Contractor's requirements, with a minimum of two, shall be provided in all areas where brazing is being carried out. Operatives shall be fully trained in the use of such appliances.

Compression joints

Compression joints are not a preferred method of jointing and shall only be used where express approval has been given in writing by the engineer. Where permission is given they shall only be used above ground and in accessible positions and below 50 mm diameter.

The joints shall be non-manipulative compression joints complying with UNI EN 1254. Compression fittings shall not be used in conjunction with phenolic foam insulation.

Internal support sleeves (typically copper, brass or stainless steel) shall be used with PE and PB pipes to prevent progressive deformation of pipe (creep) and eventual leakage. It is vital to check that the support sleeves will not be adversely affected by, or adversely affect, the liquids being carried in the pipe. Support sleeves are not interchangeable between different manufacturers.

An appropriate lubricant shall be used to avoid damage to the pipes and fittings through the use of excessive mechanical force during assembly. The choice and application of lubricants should be in accordance with the manufacturer's recommendations for the particular material.

Copper Pipework Joints

Il rame da saldare dovrà essere rame disossidato UNI EN 1057 e la saldatura deve essere eseguita solo da artigiani esperti.

All capillary and compression fittings shall be to UNI EN 1254-1.

All capillary fittings shall incorporate an integral ring of 99% Tin/1% Copper soft solder.

End feed capillary fittings with lead-based solders shall not be allowed. All jointing of copper tubes shall be strictly in accordance with the fitting manufacturers' recommendations.

Where capillary fittings are used, care shall be taken to ensure that the solder used is suitable for the temperature conditions of the system.

All jointing materials shall be manufactured from non-dezincifiable materials.
All solder droppings and surplus flux shall be removed on completion of the joint.

During all jointing operations using capillary and brazing fittings, the operative shall be accompanied by a competent assistant and suitable non-combustible mats shall be used to protect the building fabric and decoration. Every precaution shall be taken to prevent damage by scorching or fire. Portable fire extinguishers in accordance with Health and Safety requirements, with a minimum of two, shall be provided in all areas where brazing is being carried out. Operatives shall be fully trained in the use of such appliances. contractor's Safety Officer to supervise and issue Hot Works permit.
All fittings and jointing materials to be suitable for the temperature and pressure of the system.

The contractor shall follow the manufacturer's recommendations for materials and jointing on chemical injection systems used for water treatment.

In certain instances, use may be made of brazing fittings using filler metals in lieu of fittings on copper tube. Each branch, bend and weld shall be free internally from obstruction and shall only be accepted after inspection of installation.
The pipe will be flanged, belled or swaged using suitable purpose-made tools and equipment and fully annealing the pipe.
The pipe ends shall then be made the correct size for fitting and made truly round before jointing, the rough edges being filed smooth.

The pipe being welded by the oxy-acetylene method with filler rod for copper to copper jointing using a suitable flux.
Copper to be welded shall be de-oxidised copper to UNI EN 1057 and welding is only to be carried out by skilled craftsmen.

Joints for black steel pipes

Fixed joints (welds)

- Welds performed by qualified welders (according to UNI 4633 and UNI 5770-66);
- Pipe joints with a diameter less than DN 50 are usually made by autogenous welding with an oxyacetylene flame;
- Pipe joints with a larger diameter are usually made by electric arc welding with direct current;
- Ends to be welded prepared with beveling for butt welding according to UNI ISO 6761.
- Pay particular attention to the welding of small diameter pipes (< 1") to avoid obstructing the internal passage. For this purpose, also limit the use of 3/8" pipes for air venting.
- The Work Supervision reserves the right to have some radiographic checks carried out at the expense and care of the Company (max 5% of the total number of welds in an area being delivered).
- If such control indicates unacceptable welds, the Work Supervision will have other radiographic checks carried out, again at the expense and care of the Company, to verify the acceptability of the welds.
- For gas distribution networks, welds must be inspected in accordance with the aforementioned D.M. 24/11/84.

Movable joints

- Threaded joints and fittings, for diameters less than DN 50; forged steel couplings, joints sealed with hemp and sealing paste, PTFE tape seals are not allowed;
- Flange joints with butt-weld flanges UNI 2280-84 according to the nominal operating pressure; all flanges with sealing step UNI 2229 and the outer diameter of the collar corresponding to the outer diameter of the pipes (ISO); Klingerit type gaskets 2 mm thick; hex head bolts with hex nuts UNI 5727-65; flange-to-pipe connection made by electric welding.

Special pieces to be welded

- Seamless steel bends UNI 7929 type 3D (45°, 90°, 180°); or in non-alloy steel obtained by welding from hot-rolled products UNI EN 10025 Fe 360, according to UNI ISO 3419 type 3D (45°, 90°, 180°); to be butt welded;
- Cold-bent bends up to a diameter of 1" are allowed.
- Segmental or pinched bends, and elbows are not allowed;
- Concentric or eccentric reducers as shown in the drawings, or as agreed with the Work Supervision.

Fittings for Galvanised Mild Steel Pipework
Galvanized malleable cast iron fittings for diameters up to 2";

Threaded joints up to a diameter of 2", flange joints as for larger diameters;

In general, elbows or small radius bends are not allowed.

Steel tees, bends and springs for use with galvanised steel pipes shall be to UNI EN 10255 heavy grade. Ends shall be provided with screwed taper threads to UNI EN 10226-1, UNI EN 10226-2 and UNI EN 10226-3.

Galvanised malleable cast iron pipe fittings shall be UNI EN 10242 "Threaded pipe fittings in malleable cast iron" manufactured by the Whitehart process, banded or beaded for reinforcement.

Galvanised wrought steel pipe fittings shall be manufactured from mild steel by a seamless or welded process to UNI EN 10241.
The screwed ends of the fittings shall be provided with threads to UNI EN 10226, UNI EN 10226 and UNI EN 10226-3. Threaded fittings shall be in accordance with UNI EN10241.
Unions shall be manufactured with double gunmetal seats as the 'Navy' pattern and must be positioned where accessible so that they may be sprung apart.

All fittings shall be of the easy sweep type. Branches shall be made using swept tees or branch bends except where an air lock is liable to form, i.e. tees on rising mains, etc. where square tees shall be used.
Elbows shall be used only where the use of bends is impracticable and where written permission has been obtained previously.

Where standard fittings are not available for the duty required, reductions on the run end to the branch shall, in all cases, be made with reducing sockets, not bushes.
Reducing fittings on horizontal pipework shall be of the eccentric pattern fixed so as to give a smooth run to the crown of the pipe. Concentric pattern reducers shall be used on vertical pipework.

Fittings for copper pipework
Capillary and compression fittings shall be to UNI EN 1254-1. All fittings shall be manufactured from materials being non de-zincifiable.

Any fittings not in keeping with this requirement shall be replaced at no cost to the Employer.

Lead-based solder shall not be used on capillary fittings. Only 99% Tin/1% Copper solder will be permitted.

Where practical, fittings shall be of long sweep pattern. Where standard fittings are not available for the duty and sizes required, reductions shall be made with purpose-made fittings.

Where bending machines are used these shall have smooth clean guides and formers, any scored or damaged tools being rejected. Pulled bends with any deformity whatsoever resulting in the forming of the bend will not be accepted.

Unions shall be manufactured from gunmetal and shall be in accordance with UNI EN 1254-1.

All fittings and jointing materials to be suitable for the working temperature and pressure of the system.

The contractor shall strictly follow the manufacturer's recommendations for materials and jointing on chemical injection systems used for water treatment.

For stainless steel pipes
Fixed joints by welding, special pieces with welding connections;

Movable joints with threaded fittings and flanges, special pieces with threaded fittings, for pressurized networks;

Joints and special pieces with sockets and rubber rings, for drainage and ventilation networks.

2.1.1.8. Protections against freezing

Pipes exposed to the risk of freezing that cannot be emptied must be protected with tracing made with self-regulating electric heating cables, inserted by a self-regulating thermostat and connected to the BMS supervision system for monitoring.

2.1.1.9. Sizing criteria

Sizing of water conveying circuits to be carried out based on the limit velocity values, reported according to the diameters, in Tables A.1 and A.2.
Sizing of fuel gas circuits to be carried out according to UNI-CIG standards.

TABLE A.1. Maximum allowable water velocity - closed circuits

∅	DN	Internal diameter (mm)	Reference UNI	Speed (m/s)
1/2"	15	16,7	8863/L	0,50
3/4"	20	22,3	8863/L	0,60
1"	25	27,9	8863/L	0,70
1 1/4"	32	36,6	8863/L	0,85
1 1/2"	40	42,5	8863/L	0,95
	50	54,5	7287	1,1
	65	70,3	7287	1,2
	80	82,5	7287	1,3
	100	107,1	7287	1,5
	125	131,7	7287	1,65
	150	159,3	7287	1,8
	200	207,3	7287	2
	250	260,4	7287	2,2
	300	309,7	7287	2,4
	350	339,6	7287	2,5
	400	388,8	7287	2,6
	450	437,0	7287	2,8
	500	486,0	7287	2,8
	600	585,0	7287	2,8

TABLE A.2 Maximum allowable water velocity - open circuits

∅	DN	Internal diameter (mm)	Reference UNI	Speed (m/s)
1/2"	15	16,7	8863/L	0,7
		16,1	8863/M	
3/4"	20	22,3	8863/L	0,9
		21,7	8863/M	
1"	25	27,9	8863/L	1,2
		27,3	8863/M	
1 1/4"	32	36,6	8863/L	1,5
		36,0	8863/M	
1 1/2"	40	42,5	8863/L	1,7
		41,9	8863/M	
2"	50	53,9	8863/L	2,0
		53,1	8863/M	
2 1/2"	65	69,7	8863/L	2,3
		68,9	8863/M	
3"	80	81,7	8863/L	2,4
		80,9	8863/M	
4"	100	106,3	8863/L	
		105,3	8863/M	2,5
	125	132,5	6363/B	2,5
		130,7	6363/C	
	150	160,3	6363/B	2,5
		159,3	6363/C	
	200	209,1	6363/B	2,5
		207,3	6363/C	
	250	261,8	6363/B	2,5
		260,4	6363/C	

2.1.2. Plastic pipework materials

Plastic pipework shall not be used for mechanical systems unless stated within the project documents.is not generally specified; however due to project constraints plastic pipework can be used. The pipework materials tables within this specification define which services can be conveyed using the appropriate plastic pipework.

Unless specified within the project documents pipework materials shall be priced and installed on the project as detailed within the pipework materials tables within this specification. Any 'acceptable' pipework materials listed within the tables may be offered to the engineer as a value engineering option. This shall be at the discretion of the contractor, but materials shall not be ordered or installed on-site until approval is given by the engineer.

Pipework shall be marked with correct the identifier where practicable to assist recycling at end of life to UNI EN ISO 11469 Plastics. Generic identification and marking of plastics products.

Pipes, fittings and valves shall be designed to operate continuously for 50 years at their maximum rated pressure at the design working temperature.

Multilayer pipes

Cross-linked polyethylene (PE-Xa) pipes, 3, 4, and 5 layers, produced using the Engel method with a minimum cross-linking of 70%, compliant with DIN 16892/93 and UNI EN 15875 standards; fire resistance Class B (DIN 4102); operating temperature and pressure: 70°C/10 bar; max temperature: 95°C.
The raw material is virgin high-density polyethylene with high molecular weight. The cross-linking occurs directly during the extrusion phase and ensures uniformity of the cross-linking degree throughout the entire mass of the pipe.

Characteristics

- Corrosion and erosion resistance
- Low pressure losses
- Quietness
- Lightness
- Thermal memory
- Flexibility
- Frost resistance
- Non-toxicity
- Mechanical strength
- Workability at low temperatures

The type of piping must be suitable for the use of water treatment products specified in the project or already in the field.

2.1.2.1. Manufacturer's Testing

Process control testing must be carried out during manufacture and documented on each and every production batch.

Fittings and pipework shall be subjected to a pressure test of three times maximum recommended working pressure for one hour at 20°C during 1st and 2nd hours of production, then every six hours for fittings and eight hours for pipes.

Pipework shall also be impact tested after conditioning at 0°C for one hour. Fittings shall also be subject to stress relief testing at 150°C. Pipes and fittings shall undergo dimensional, marking, and visual inspection at each production batch.

2.1.2.2. Electrical conductivity

Plastic cannot be used for earthing purposes as no plastic is sufficiently conductive to function as part of an earthing system. Therefore, if replacing a section of metal pipework (used for earthing purposes) with a plastic system, it is necessary to maintain electrical continuity using a bonding lead spanning the plastic section and firmly attached with conductive clips / clamps to the metal pipework.

2.1.2.3. Ultra-Violet-Light (UV)

Plastics are vulnerable to UV light; however, their degree of vulnerability varies with the material and the level of stabilisation.

Should the installation be considered vulnerable to sunlight, including where pipes in buildings pass windows, covering is recommended.

Storage of exposed pipes for prolonged periods of time shall also be avoided. A covering should be used for long-term storage. Pe-X shall be covered at all times as few protective pigments are available.

2.1.2.4. Mixing of pipe materials and fittings

In order to ensure security of performance, pipework and fittings from the same manufacturer shall be used at all times.

Where mixing metal and plastic systems no hot works joints shall be made closer than 1 m to an installed plastic-to-metal adapter.

2.1.2.5. Methods of Jointing

Solvent welding

The installer shall only use cements recommended by the manufacturer. As not all types of plastic pipework are suitable for solvent welding the installer shall obtain specialist advice if solvent welding different materials together, e.g. ABS to PVC.

The manufacturer's instructions should be followed for the preparation of pipework and application of solvent cement to ensure satisfactory joints.
Solvent cements can have a limited shelf life whether opened or not. The date shall be checked for suitability prior to use.

Joints shall not be made:

- In the Rain or Wet Conditions.
- Using dirty brushes or cleaning rags, which are dirty or oily.
- Using the same brush for different solvent cements.
- With Diluted or thinned solvent cements with MEK cleaner.
- With a solvent cement which has been left open.
- Near a naked flame.
- In a confined space.

Smoking, welding and naked flames shall not be permitted in the vicinity local to the where pipes are being welded due to the flammability of the solvents.
Adequate ventilation shall be provided whilst jointing since vapours are flammable, narcotic and potentially lethal.

Care shall be taken when using solvent cements and cleaners as they are hazardous and inflammable. Precautions must be taken in their use to protect the health and safety of those affected. Refer to manufacturers' information and any assessments made under Control of Substances Hazardous to Health (COSHH) and Dangerous Substances and Explosive

Atmospheres Regulations. Cement must be locked within a secure place when not in use. Old cement containers shall be properly disposed of with due regard to Regulations. Old solvent cement containers shall not be placed in an open skip.

Test pressures shall not be applied until a minimum of 24 hours has elapsed following jointing.
Welds for inspection and testing shall be selected at random by the engineer.
Each welder shall provide a test specimen, manufactured under working conditions and witnessed by the engineer, for each type of weld to the relevant standard.

Physical testing shall be applied to three of the first ten production welds made by each welder.
Should any weld be rejected or require rectification, then a further three welds, by the same operator, shall be selected for examination. In the event of further failure in these welds, all the welds performed by the particular operator may be liable to rejection by the engineer.
Physical testing shall comprise:

- The weld to be cut out for test purposes.
- The weld to be subject to visual examination and bend tests in accordance with the relevant standard.
- The weld to be re-made.

Alternatively, the welder may prepare a test specimen made up of two similar lengths of pipe welded in a position closely representative of the selected production weld and witnessed by the engineer.
Should more than 10% of those welds tested prove unsatisfactory, a further 5% of all welds shall be tested. Records of the tests and the results shall be issued direct to the Engineer with a copy to the contractor.
Once installed the system shall be pressure tested to 1.5 times the working pressure.

Flanged

Particular care is required with respect to bolt tightening sequence and torque applied to bolts to avoid distortion.

To ensure an effective seal the gasket and flange faces should be clean and free from dirty or other obstructions.

Full-face flange fittings (for plastic to plastic) generally require purpose-designed backing rings to spread the bolt load and full-face gaskets. Use of the correct backing ring and gasket is essential.

Thermal fusion and electrofusion

Fusion joints, whether butt, socket or electrofusion joints on plastic pipework shall only be carried out by full trained operatives and strictly in accordance with the manufacturer's instructions.

A sample of test pieces shall be produced for each fusion joint to be used. These shall be demonstrated to the engineer before the works commence onsite. Tests shall be in accordance with UNI ISO 11414 Plastics pipes and fittings. Preparation of polyethylene (PE) pipe/pipe or pipe/fitting test piece assemblies by butt fusion and UNI ISO 11413 Plastics pipes and fittings. Preparation of test piece assemblies between a polyethylene (PE) pipe and an electrofusion fitting.

Butt welding

To be performed only by trained operators strictly following the manufacturer's instructions. The welding must comply with the UNI ISO 21307 standard for plastic pipes and fittings. Butt fusion procedures for polyethylene (PE) pipes and fittings used in the construction of gas and water distribution systems.

Socket welding

Thermal fusion requires considerable skill to prevent heat damage and to obtain satisfactory joints.

Manufacturers' advice should be sought concerning maximum permissible temperatures and the suitability of any given pipe for such welding. Only trained operatives shall be used.

Compression fittings

Manufacturer's instructions should always be followed, with respect to preparation of pipework, to ensure satisfactory joints. Some plastic pipe can be used with standard brass compression fittings, but most manufacturers provide alternative plastic fittings, which offer easy and quick installation.

Internal support sleeves (typically copper, brass or stainless steel) shall be used with polythene and polybutylene pipes to prevent progressive deformation of pipe (creep) and eventual leakage. It is vital to check that the support sleeves will not be adversely affected by, or adversely affect, the liquids being carried in the pipe. Support sleeves are not interchangeable between different manufacturers.

Some manufacturers recommend the use of an appropriate lubricant to avoid damage to the pipes and fittings through the use of excessive mechanical force during assembly. The choice and application of lubricants should be in accordance with the manufacturer's recommendations for the particular material.

Push-fit

These shall not normally be used except where agreed with the engineer.
Manufacturer's instructions should always be followed with respect to preparation of pipework to ensure satisfactory joints.

2.1.2.6. Expansion and contraction rates

The route chosen for the pipework and the design of brackets and clips should allow for the thermal expansion of plastics which is far higher than for metals. Manufacturer's recommendations should be obtained and applied to all design / installation practice.

Expansion loops or suitable compensators may be required, but ideally the design of the system should make use of the pipe's natural flexibility.

2.1.3. Pipework for specific application

2.1.3.1. Refrigerant pipework

Copper pipework and fittings shall be as previously described.

Copper tubes for refrigerant pipework shall comply with UNI EN 12735-1 Copper and copper alloys. Seamless, round tubes for air conditioning and refrigeration and shall be suitable for the refrigerant and oil used. Tubes shall be dry and absolutely free from scale.

Fittings shall be integral ring solder fittings complying with UNI EN 1254-2 Copper and copper alloys. Plumbing fittings or shall comprise brass or bronze brazing fittings. Formed bends shall be used in preference to pulled fittings.

Refrigeration pipework joints shall be brazed as previously described.

Dry nitrogen shall be bled continuously through the pipework at minimal pressure during brazing or soldering to eliminate oxidation.

Brazing shall be carried out in accordance with UNI EN 14324 Brazing. Guidance on the application of brazed joints by operatives having passed approval examinations in accordance with that standard.

The number of joints shall be kept to the absolute minimum.

Installation of refrigerant pipework shall comply with Guide to Good Practice for Commercial and Light Industrial Refrigeration and UNI EN 378 Refrigerating systems and heat pumps.

Electric cables shall not be fixed to refrigerant pipework, to the supports or to the same tray-work.

Refrigerant pipework shall be adequately supported with maximum support spacing as detailed within the Table below:

Nominal bore (mm)	Support Spacing (m)
15 to 22	1.0
22 to 54	2.0
54 to 67	3.0

Where the pipework cannot be adequately supported at these spacings directly from the building structure, continuous proprietary channel, angle or tray support systems shall be provided. Pipework shall be supported by sheradised steel clips with a rubber or plastic sleeve to prevent chafing or vibration. The arrangement of pipework and support shall be agreed with the engineer before installation.

Where the vertical rise exceeds 3m, an oil trap shall be formed in the suction line at the base of the riser and at 3m intervals throughout the length of the riser, or at such intervals as are recommended by the refrigerant plant manufacturer. Horizontal lines shall slope downwards in the direction of flow.

Refrigerant pipework shall comprise the materials detailed within the Table below:

Material	Accessible Pipework			Concealed Pipework	
	Up to 65 mm	65 – 150 mm	>150 mm	Up to 150 mm	>150 mm
Copper	Preferred	Preferred		Preferred	
Brazed	Preferred	Preferred		Preferred	
Flanged	Accepted	Accepted			
Screwed	Accepted	Accepted			

2.1.3.2. Pipings for domestic water and drainage

The pipes for the various networks will be made as specified below:

The horizontal pipes for the discharge of black water from sanitary fixtures to the connection to the underground collectors will be made of HDPE. They will be complete with special pieces, expansion joints, and, where necessary, electrical sleeves.

The drainage network will be complete with the necessary inspections and traps.

The horizontal pipes for the construction of underground collectors will be made of PVC type SN8 (formerly 303/1) compliant with the UNI EN 1401-1 standard. They will be complete with special pieces, expansion joints, and, where necessary, electrical sleeves. The drainage network will be complete with the necessary inspections and traps.

Refer to document *4025 ES E CM 02-* for further information on underground networks.

2.1.3.3. Secondary circuit from CDU to rack pipework materials

The secondary circuit distribution network from the CDUs to the racks will be made of AISI 316 stainless steel.

DESIGNAZIONE E NORME						
UNI-EN 10088-1		AISI	Astm	Werkstoff	Afnor	Bs
x5CrNi18.10	1.4301	304	TP 304	1.4301	Z7CN18.9	304 S15
x2CrNi18.9/19.11	1.4306/1.4307	304L	TP 304L	1.4306/1.4307	Z3CN18.10	304 S11
x5CrNiMo17.12.2	1.4401	316	TP 316	1.4401	Z7CND17.11.02	316 S31
x2CrNiMo17.12.2	1.4404	316L	TP 316L	1.4404	Z3CND17.11.02	316S11

DESIGNAZIONE			ANALISI CHIMICA INDICATIVA %			
UNI-EN 10088-1		AISI	C max	Cr range	Ni range	Mo range
x5CrNi18.10	1.4301	304	0,07	17 ÷ 19,5	8 ÷ 10,5	-
x2CrNi18.9/19.11	1.4306/1.4307	304L	0,03	17,5 ÷ 19,5	8 ÷ 10	-
x5CrNiMo17.12.2	1.4401	316	0,07	16,5 ÷ 18,5	10 ÷ 13	2 ÷ 2,5
x2CrNiMo17.12.2	1.4404	316L	0,03	16,5 ÷ 18,5	10 ÷ 13	2 ÷ 2,5

I materiali sopra indicati possono essere saldati senza trattamento termico addizionale.

The pipe specifications are in the previous paragraphs. T
he pipes are longitudinally welded with argon, calibrated according to DIN 11850 and SMS standards.
The internal surface is deburred, satin-finished, or polished.
The external surface is pickled or automatically polished.

The joints must be flanged or clamped according to the nominal design pressure, and it must be ensured that no machining chips are released into the fluids to avoid damaging the equipment.

The water in the secondary circuit must be a 30% mixture of glycol type *Dowfrost LC25*.

Each branch serving the racks must have a pressure-independent flow limiting valve.

All valves and accessories in the secondary circuit (from the CDUs to the racks) must be made of AISI 316 stainless steel.

All connection joints must be able to withstand a nominal pressure of PN10.

The secondary circuit test (CDU to Rack) will be performed at a pressure equal to 1.5 times the nominal pressure.

All pipes and accessories (valves, fittings, etc.) in the secondary circuit (CDU to Rack) must be insulated with a thickness of 50mm and finished with aluminum sheet.

The pipe insulation will be carried out with a fire reaction class of B-s3,d0.

The applicable standards for joints, connections, and components must be defined with the Client and the End-User.

NO ELEMENT OF THE L2L CIRCUIT (CDU – RACK) CAN BE INSTALLED BEFORE RECEIVING FORMAL APPROVAL FROM THE CLIENT.

2.2. Piped services installation

This section of the specification defines the general standards, methods, and processes to be adopted for the supply and installation of pipes, valves, and fittings. Specific requirements are described elsewhere in this specification. The requirements for sprinkler installations are described in the Fire Protection section.

The piping systems must comply with the appropriate Italian code of conduct for the system. Water services must also comply with the appropriate water supply regulations for the works. The black and industrial water drainage systems must comply with building regulations and local authority regulations. The installation of the pipes must be carried out in accordance with all Building Regulations and the Italian Standards or Codes of Conduct in force at the time of installation.

The materials and equipment installed must be accompanied by a certificate in accordance with the current national standard.

Materials must be stored in dry conditions and in a way that prevents damage or corrosion. The site management will reject improperly stored material.

Unless otherwise specified, all listed pipe sizes are nominal internal dimensions.

2.2.1. Incoming water

All drawings and equipment specifications are to be in accordance with the relevant Water Company's Requirements and Bye-Laws before any installation is commenced. Due notice is to be given to the Water Company and-other relevant Authorities before any work is commenced on site, by the contractor.

The incoming water main will be connected to the town's main by the water company. The contractor shall include for the costs of this work. Where the main passes through a substructure retaining wall, a puddle flange pipe shall be provided by the contractor.

The joint between the main and the puddle flange pipe will be waterproofed by the contractor.

The contractor shall be responsible for the liaison with the Water Company and the extension of the main into the building and any requirements regarding the Contractor's building site water supply.

The contractor shall connect to the main inside the site boundary.

The contractor shall check all levels and the like for the connection of the main before any work is carried out and shall make all necessary arrangements with the water company for the work to be completed and shall be responsible and allow for all reinstatement of public footpaths and roads, etc. and to carry out all works to suit the main programme.

From the point inside the site boundary, the main shall be valved and a water meter fitted to water company installation requirements. After the meter installation, an injection and sampling point shall be provided. The service shall then be run to serve all mains fed equipment and appliances.

The whole of the incoming main from the street to the main isolating valve and its connection to the water company's main, shall be tested after installation by the Water Company to meet their full requirements.

2.2.1.1. Incoming water meter

The flow water meters installed on the incoming domestic network must be installed according to the requirements of the Water Company.

The meters must be installed 0.6 m from the floor without a bypass installed and must comply with the Water Company's standard drawings and installation details.

The Water Company must provide each meter, complete with appropriate adapters for fixing by the contractor to the supply pipe in the position agreed with the Authority.

The shut-off valves must be fixed so that the meter assembly can be easily isolated for removal, etc., and must comply with UNI EN 1213.

2.2.2. Pipework and materials for hot and cold water

Cold Water

Pipe Material: Polyethylene						**External Buried Water Services**
Tube						**Up to 54mm**
High density polyethylene						✓ 1
Jointing						
Welding						✓ 1
Compression Type B						✓ 1
Pipe Material: Steel						**External Below Ground**
Tube			**Blue MDPE**			**Blue MDPE**
		PE80		**PE100**		**Protector line for Brown Land Sites**
Medium Density Polyethylene Pipes and fittings UNI EN 12201 "Plastics piping systems for water supply, and for drainage and sewerage under pressure"						
	Part 1 Part 2	12 Bar	8 Bar	16 Bar	10 Bar	
25-63		✓				✓
90 - 630			✓			✓
90 - 180				✓	✓	
90 - 630				✓	✓	
Jointing						
Electrofusion		✓	✓	✓	✓	✓
Push Fir	up to 63	✓	✓	✓	✓	
Compression	up to 63	✓	✓	✓	✓	✓

Note: Underground services follow national standards.

Hot and Cold-Water Services within Buildings

From the distribution manifolds to the individual fixtures, the pipes for cold and hot water will be of the insulated multilayer type.

Pipe Material: Steel		**Accessible**		**Without direct access or permanently concealed**	
Tube	**<65 mm**	**65 – 150mm**	**>150mm**	**Up to 150mm**	**>150mm**
Galvanised Mild Steel Tube UNI EN10255 "Non-alloy steel tubes suitable for welding and threading. Technical delivery conditions"	✓	✓	✓	✓	
Jointing					
Threaded	✓				
Flanged	✓	✓	✓		
Grooved	✓2	✓			
Mechanical press fit	✓3	✓3			
Malleable Cast Iron Fittings	✓				

Pipe Material: Copper		**Accessible**		**Without direct access or permanently concealed**	
Tube	**Up to 67mm**	**67 – 159mm**	**>159mm**	**Up to 159mm**	**>159mm**
Copper Tube UNI EN1057 "Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications"	✓				
Jointing					
Solder	✓				
Compression	✓1				
Capillary	✓				
Brazed	✓	✓	✓	✓	✓
Pulled Bends	✓			✓	
Press Fit	✓3	✓3			
Push Fit	✓4				

Notes to the previous tables:

- Not recommended above 54 mm.
- Normally not used below 50 mm.
- To be used only with the pipe recommended by the manufacturer.

- Available only in sizes up to 22 mm and subject to low temperature and operating pressure.

Pipeline Material	Temp °C Range Subject to Pressure	Typical Pressure Range @ 20 °C	ABS	PB	PEX	PVC-C PVC-U	Multi-Layer	PE100 (HDPE)	PP	PVDF
Plastic	-5 °C To 60 °C	0-5 Bar	✓	✓	✓	✓	✓	✓	✓	✓
		5-10 Bar		✓	✓		✓		✓	✓
		10-20 Bar		✓	✓		✓			✓

The maximum operating temperature varies depending on the type and brand of the pipe.

Jointing	ABS	PB	PEX	PVC-C PVC-U	Multi Layer	PE100 (HDPE)	PP	PVDF
Threaded	✓					✓		
Solvent	✓			✓				
Flanged	✓	✓	✓	✓		✓		
Thermal -Fusion							✓	✓
Butt-weld						✓	✓	✓
Socket Weld								
Electrofusion							✓	✓
Compression		✓	✓					
Push Fit						✓		

Pipeline Material	15 – 208 mm	Temperature Range °C	Pressure
Stainless Steel UNI EN 10312 "Welded stainless steel tubes for the conveyance of aqueous liquids including water for human consumption	**15-54 mm**	-20 °C to 110 °C	

Jointing	UP to 28 mm	35 – 108 mm		Pressure
Pulled Bend	✓			
Press Fit	✓	✓	-20 °C to 110 °C	16
Compression	✓			

The above indications do not apply to the CDU/Rack secondary circuit for which all joints must be flanged.

2.2.3. Routing of pipework

Pipework shall follow the contours of the building with due consideration to venting and draining, which is amplified elsewhere. Pipework shall be formed around all projections and recesses. It shall be offset as required due to varying thicknesses of walls, floors, ceilings and other structural works or services, whether such changes in direction are indicated on the drawings or not.

Pipework shall also be installed to accommodate any movement within the pipework system or movement of the building structure by the introduction of expansion devices as required.

The route chosen for the pipework and the design of brackets and clips should allow for the thermal expansion of plastics. Manufacturer's recommendations should be obtained and applied to all installation practises. Expansion loops or suitable compensators may be required, but ideally the design of the system should make use of the pipe's natural flexibility.

The use of dissimilar materials where they are liable to cause corrosion shall be avoided. Joints shall not be made in the thickness of any wall, floor or ceiling and pipework shall not be embedded in brickwork or concrete unless specially agreed.

Formed bends and sets shall be used where practical. Curved or long sweep bends and branches shall be used as far as is practical. Where air pipes, air bottles, drain or dirt pockets or air venting requirements dictate, square connections and fittings shall be used.

Fittings shall be of the same size as the pipe in which they are installed. Bushing down will not be accepted. Changes in diameter in pipe runs shall be made with reducers. Eccentric reducers shall be used where necessary to permit venting and draining.

Unions or flanged joints shall be installed to permit dismantling at a maximum spacing of 12 metres on pipe runs, at plant items and on the dead side of all isolation, regulating and commissioning valves

Unions shall also be provided to allow control valves, strainers and the like to be removed for maintenance purposes.

Spacing and reinforcement of branches shall comply with UNI EN 13480 Metallic industrial piping.

<u>Metallic industrial pipework.</u>
The distance between any two branches must not be less than the sum of their external diameters. The arrangement of fittings in branch connections or other fixed points of the system must allow movement without causing undue stress on the pipes. The pipes must be arranged to reduce stress on the systems and equipment due to expansion.

The pipes must turn around pillars and all other protrusions and recesses, and for all displacements due to varying thicknesses of plaster, walls, floors, ceilings, and other structural works. In any case, complete details regarding the heights of skirting boards, thresholds, false floors, and floor finishes must be provided.
The circuits will be perfectly balanced by inserting, where indicated on the drawings or otherwise necessary, calibration valves or diaphragms.

The connection of the pipes to the equipment must always be made with flanges or three-piece unions.
In the case of laying pipes embedded in the floor or wall, the pipes must be covered with insulating sleeves such as Armaflex or similar with a minimum thickness of 9 mm.

Black steel pipes must be cleaned before or after assembly with a wire brush: subsequent painting with two coats of rust-resistant paint suitable for the temperature of the passing fluid, each of a different color; the second coat applied only after approval by the Work Supervision.

For the discharge of condensate water and for the formation of drains subject to the waterline, adopt galvanized pipes with threaded fittings in galvanized malleable cast iron (up to 4").

On the pipes, in the positions indicated on the drawings or agreed with the Work Supervision at human height, provide connections for the insertion of thermometers, pressure gauges, and measuring instruments in general.

Pipework protection

Open ends left during the progress of the work shall be blanked off with purpose-made metal or plastic plugs, caps or blank counter flanges. Wood, paper, cloth or other similar materials will not be permitted. Where open or improperly blanked ends are left, the engineer may require that the pipework is disconnected for inspection. Such disconnection shall be taken sufficiently far back and be carried out in such sections as to determine that the bores have not been obstructed by foreign matter.

Pipework, fittings, support steelwork and brackets shall be thoroughly cleaned immediately on completion. One coat of zinc-based primer shall then be applied to all ferrous pipework, fittings, support steelwork and brackets.

Before any existing main is cut, it shall be checked to ensure that it is isolated and drained as far as is possible, or that the internal pressure has been released.

Pipe support blocks

The insulation at pipe support points shall be chlorofluorocarbon (CFC) free high density phenolic foam sections contained within metal sleeves or hardwood made to the same thickness as the adjacent pipework insulation.

The foil-face aluminium finish shall be continuous through the support and sealed. Where phenolic foam is used, a metal bearing plate shall be situated between the insulation and pipe support to avoid point loads on the insulation.

2.2.4. Supports and fixing

The supports must be pre-studied by the Contractor, and the related construction drawings must be submitted for approval by the Work Supervision. Improvised solutions are not accepted.

The sizing of the supports must be based on:

- Weight of pipes, valves, fittings, insulation, and generally all suspended components
- Stresses due to earthquakes, hydrostatic tests, water hammer, or activation of safety valves
- Stresses resulting from thermal expansions.

In any case, the contractor must submit the construction drawings detailing the position and forces related to the fixed points for prior approval by the Work Supervision.

The position of the supports must be chosen based on: pipe size, route configuration, presence of concentrated loads, available structures for anchoring, and movements due to thermal expansion.
All pipes must be adequately supported and braced and must allow, where required, adequate free and/or guided movement due to the operating conditions that occur. The extent of such movement will be proportionate throughout the system, providing anchors at suitable points. The pipes must be arranged to accommodate linear expansion without distortion when heated or cooled. The pipe supports must allow for the complete movement of the pipes except at fixed

points, which must be provided as needed between expansion points. Fixed points must be secured by carefully designed anchors.

The supports must be anchored to the structures with one of the following devices:

- Omega profiles,
- Ceiling expansion anchors,
- Wall brackets,
- Clamps and collar supports.

In any case, the supports must be designed and constructed in such a way as to prevent the transmission of noise and vibrations from the pipes to the structures.

Pipes conveying hot fluids must have supports that allow movements due to thermal expansion. In particular:

- Sliding supports with interposed anti-friction material (static friction coefficient not exceeding 0.35) for diameters less than or equal to DN 100;
- Roller supports for diameters greater than DN 100.

The rollers must be keyed on anti-friction material bushings and must be fixed to the supports preferably with bolted connections, to allow centering adjustments.
In all cases where there are transverse movements to the pipe axis, rollers with appropriate transverse play of the bushings on the rolling pins must be provided.

Where strictly necessary, and with the explicit approval of the Work Supervision, pendulum supports may be used; in any case, the angular deflection of the tie rod, due to thermal expansion movements, must be contained within 4°.

The table below shows the minimum dimensions of the tie rods. If the available space does not allow for the prescribed lengths of the tie rods, spring suspensions must be used.

Threaded Rod Dimensions

DISTANCE FROM FIXED POINT m	MINIMUM ROD LENGTH m
Up to 20 From 20 to 30 From 30 to 40	0,30 0,70 1,20
PIPE DIAMETER Nominal diameter	THREADED ROD DIAMETER mm
Up to DN50 from DN50 to DN100 from DN125 to DN200 from DN250 to DN300 from a DN350 to DN400	8 10 12 16 20

Pipes must be supported by approved support saddles, chosen according to the load. These saddles must have a height greater than the thickness of the insulation.

Supports must be provided to allow for movements due to thermal expansion, even for chilled water pipes, in the presence of thermal expansions that lead to unacceptable stresses on the pipes or supports.

Direct laying on profiles of non-insulated pipes can only be carried out with the explicit approval of the Work Supervision.
Interruptions in insulation at the supports are not allowed; the insulation must be penetrated, where strictly necessary, in such a way as to have finished surfaces and to avoid damage to the insulation due to thermal expansion movements.

The saddles of the movable supports must be of such a length as to ensure a secure support on the underlying roller, both in hot and cold conditions.

Insulated cold pipes must be supported in such a way as to ensure the continuity of the vapor barrier. No discontinuity of the insulation is allowed.
Semi-circular galvanized sheet metal support shells must be provided, placed outside the insulated pipe. The following table shows the minimum dimensions of these shells.

Minimum dimensions of support shells for insulated cold pipes

PIPE DIAMETER	LENGHT mm	THICKNESS mm
DN80 or less	300	1,20
DN100	320	1,60
DN125	380	1,60
DN150	450	1,60
DN200 and over	600	2,00

Particular care must be taken by the contractor in the design and method of supports and brackets for pipework and associated equipment. The materials, construction, method of fixing, practicability and appearance of the brackets must be carefully considered by the contractor.

Full information shall be obtained concerning the co-ordination and distribution of other services and plant within the building. No additional costs will be allowed for altered pipework which may be necessitated by non-observance of this clause.

Full and proper care shall be exercised in the positioning and marking out of all brackets and supports. Brackets and supports shall be set out so that they do not obstruct the access to valves, flanges or fittings requiring maintenance.

Pipes shall not be supported from each other. The brackets so installed shall not prevent the removal of any individual pipe where necessary and provision shall be made for unequal expansion where applicable.

Pipes shall not be supported from any items of equipment, or plant.

All pipes exposed to view and generally around rooms at floor level shall be supported on schoolboard pattern long shank built-in or screw-in brackets.

Pipe brackets on exposed copper pipework shall be of the cast brass type. Under no circumstances will brass strip or copper strip type brackets be acceptable.

Brackets on insulated pipework incorporating a vapour seal shall be fitted with hardwood insulators pre-wrapped with aluminium foil adhesive tape between the insulator and bracket to form the basis of a continuous vapour seal. Brackets in this instance shall be two-piece zinc-plated steel pipe clamps. Mild steel brackets will not be acceptable.

Materials for supporting and fixing the various items of piping, tubing, etc., are to be issued to the engineer for comment.

It shall, however, be a firm principle of all fixing that the contact of dissimilar metals will not be permitted and to this end steel piping shall have steel supporting members in contact with the pipe, galvanised piping shall have galvanised contacts and copper tubing shall be carried exclusively from contact members constructed from copper or copper alloy, or where

steel clamp saddles are used, a plastic lining interposed. All spring washers, shakeproof items, locknuts, etc., shall be included.

Structural steelwork shall not be drilled either for the passage of pipes or the attachment of brackets, nor shall steelwork be welded to, without written permission from the structural engineer.

In all positions throughout the building, all necessary supports and brackets complete with all bolts, screws and insert or plug fastenings shall be provided.

All fastenings and fixings to the constructional and fabric elements of the building shall be included. All methods of fixing and fastening shall be purpose designed and approved. Direct fixing, self-drilling and normal drilling methods of fixing to concrete slabs will be considered for approval.

On hollow construction and plasterboard studwork partitioning, proprietary or purpose-made pipework support systems shall be provided for independent fixing of pipework services. Fixings will not be allowed to such hollow construction and plasterboard studworks partitioning. The contractor shall submit full details of his fixing details for comment by the engineer prior to commencement of the works.

Main walls and partition walls, etc., where pipes pass through sleeves, shall not be considered as pipe supports.

The spacing of the supports shall conform to those given in the table and the distance shall not be exceeded.

In addition to the centres given, supports shall be provided adjacent to all valves, flanged joints and other special components to prevent undue strain on the adjoining pipework and so that the components or sections of pipework may be removed, leaving the adjoining pipework adequately supported at the ends.

Vertical pipework shall be suitably supported at the base of the riser and at all intermediate levels. Branch circuit pipes shall not be used as a means of support for the riser main.

Wherever possible services shall be grouped in risers, ducts, suspended ceiling, etc. and a unitary bracketing system may be used. Where ferrous brackets are used with non-ferrous pipework suitable liners shall be interposed.

On conventional surface brackets mild steel or cast iron shall be used with ferrous pipes and brass shall be used for copper pipes.

Pipework in exposed positions shall be supported using brackets screwed or plugged to the walls. Mild steel pipe brackets shall be malleable iron with black enamel or galvanised finish to suit the pipe.

Where exposed pipework is specified as being chromium-plated, the support brackets shall be similarly chromium-plated.

Where pipework is insulated, supports shall be designed to maintain the specified spacing from adjacent surfaces.

All external pipe supports and brackets shall be mild steel zinc-plated after manufacture at works. The assembly on site shall in no way deteriorate the quality of the galvanising.

The spacing of pipework supports shall conform to those given in the following tables. Where two or more pipes are supported on one fixing, the support centres shall be based upon the requirements of the smallest diameter pipe or the material with the smallest spacing distance.

In addition to the spacings given below supports shall be provided adjacent to all valves, flanged joints and other special components to prevent undue strain on the adjoining pipework and so that the components or sections of pipework may be removed, leaving the adjoining pipework adequately supported at the ends.

The maximum support spacing distances for steel and copper pipework shall be as detailed within the Tables below respectively, except other prescriptions noted on single systems standards (i.e. fire protection systems).

At the structural joints, appropriate anti-seismic joints capable of absorbing the following displacements must be installed on the pipes that pass through them.

Displacement shall be +/-100mm horizontal plane and +/-50mm vertical displacement.

Maximum Support Spacings:

Steel Pipework

Diameter (mm)	Horizontal (m)	Vertical (m)
15	1.8	2.4
20	2.4	2.7
25	2.4	3.0
32	2.4	3.0
40	2.4	3.6
50	2.4	3.6
65	3.0	4.2
80	3.0	4.2
100	3.0	4.6
125	3.7	5.5
150	4.5	5.5
200	5.0	6.0
250	5.5	6.0
300	6.0	6.0

Copper Pipework

Diameter (mm)	Horizontal (m)	Vertical (m)
15	1.2	1.8
22	1.8	2.4
28	1.8	2.4

35	2.4	3.0
42	2.4	3.0
54	2.7	3.0
67	3.0	3.6
76	3.0	3.6
108	3.0	3.6
133	3.0	3.6
159	3.6	4.2

2.2.5. Plastic pipework supports

The supports must have sufficient width to provide a low concentrated load on the bottom of the pipe. Manufacturers usually provide guidelines on the recommended minimum support areas in addition to the support intervals. In some cases, continuous support may be necessary to prevent sagging.

Support for plastic pipes should generally provide lateral containment while allowing axial movement (due to thermal expansion). Pipe clamps should be chosen to allow axial movement at all temperatures.

As a first choice, it is advisable to use patented plastic hose clamps. Metal clips must be sized not to compress the pipe. Ensure that the screws in single-screw fastenings do not protrude from the countersink.

Suspension-type supports do not provide good lateral containment, which can lead to swaying. They are generally not suitable unless reinforced in two directions.
Heavy pipe components should not be supported by plastic pipes.

To make the most of the pipe's flexibility, it is best not to place the clips too close to changes in direction. When using pipe clamps to secure a bend, potential loads on the clip must be considered.
Manufacturers' recommendations on the minimum bending radius must be followed. For tight bends in soft pipe materials, formers may be available.

For gravity mechanical drains using plastic pipework, pipework below 25 mm shall be supported with traywork to prevent sagging or damage to the pipework.

The maximum support spacing distances for plastic pipework shall be as detailed within the Tables below.

Plastic Pipework Maximum Support Spacings

Diameter (mm)	Horizontal (m)	Vertical (m)
15	0.9	1.2
20	0.9	1.2
25	1	1.3
32	1.2	1.6
40	1.4	1.9
50	1.5	2

Diameter (mm)	Horizontal (m)	Vertical (m)
65	1.6	2.1
80	1.8	2.4
100	2	2.6
125	2.2	2.9
150	2.4	3.2
200	2.8	3.7
250	3.2	4.2
300	3.6	4.7

2.2.6. Seismic supports

Depending on the installation configurations and the acting loads, the following bracing options are possible:

- Single pipe braced transversely
- Single pipe braced longitudinally
- Trapeze with threaded rod braced transversely
- Trapeze with threaded rod braced longitudinally
- Trapeze with threaded rod braced in 4 directions
- Trapeze with rails braced transversely
- Trapeze with rails braced longitudinally
- Trapeze with rails braced in 4 directions
- Trapeze with threaded rods braced longitudinally
- Trapeze with threaded rods braced transversely
- Trapeze with threaded rods braced in 4 directions
- Wall bracket braced longitudinally

2.2.6.1. Construction features

The bracing will consist of modular systems for medium-heavy applications.

The rails used must be made of S250 GD steel according to EN 10326, with a ribbed C-section, with serrated edges to facilitate engagement with the mounting bolts and protected by a 20-micron thick sendzimir galvanization.
All necessary connecting elements must be made of S235 JR steel according to EN 10025, made from 4 mm thick sheet metal with a 13-micron thick sendzimir galvanization.

The attachment of accessories (angles, rail bases, etc.) to the installation system rails must be done using a universal zinc-plated connecting bolt, with an M10 screw in class 8.8 steel and a pre-assembled hammerhead with internal knurling to allow engagement on the bending of the C-profiles and to ensure tensile and shear resistance.

The piping must be supported by suitable collars made of galvanized S235 JR steel according to DIN EN 10025 or galvanized DD11 steel according to DIN EN 10111, which will be anchored to the rails using zinc-plated hammer nuts internally threaded type MQA, suitable for inserting threaded rods on profiles for installation systems.

The transverse and longitudinal seismic bracing will be made using:

- Seismic angle, made of S275JR steel according to EN 10025-2, made from 4 mm thick sheet metal, with side fins with a 10.5 mm diameter circular hole to allow the attachment of seismic hinges for bracing made with rails or threaded rods. The angle is slotted with "butterfly" holes to allow engagement with C-profiles using universal connecting bolts for installation systems; it is provided with a side bend and a front tooth that improve the connection with the C-mounting rail. The angle is completed with a U-shaped reinforcement bracket that wraps around the underlying longitudinal mounting rail and is fixed to the angle through two M10x25 screws in class 8.8 steel and two M10 nuts in class 8.8 steel.
- Pre-assembled seismic hinge made of S275 JR steel according to EN 10025. Consisting of two parts: the upper part, 4 mm thick, has one or two 35x19 mm "butterfly" slotted holes to allow engagement with C-profiles using universal connecting bolts; the lower part, 6 mm thick, has a circular hole (diameter 11.5 mm or 13.6 mm) and is connected to the upper part through an M10x25 screw in class 8.8 steel and an M10 nut in class 8.8 steel.

2.2.6.2. Fastening system

Supply of mechanical screw anchors for fastening structural steel elements to concrete for applications with reduced thicknesses and/or edge distances and/or spacings, which must have CE marking and ETA evaluation, in seismic category C2 for seismic-resistant supports. Supply of seismic mechanical anchors for fastening structural steel elements to concrete for applications with reduced thicknesses and/or edge distances and/or spacings. The mechanical anchor must have CE marking and ETA evaluation, in seismic category C2. The hole should be made using rotary percussion or coring or with automatic drilling systems. The annular space between the anchor and the hole can be filled using the seismic filling set.

2.2.6.3. Positioning and Installation Criteria

Seismic bracing spacing according to "SMACNA" - Seismic Restraint Manual for Mechanical Systems. For thermohydraulic systems, an excerpt from the aforementioned manual is provided:

Table 8-3 Steel and Copper Pipe with Welded, Brazed, Grooved, or Screwed Connections

Maximum Seismic Acceleration Input (g)	Maximum Transverse Brace Spacing, ft (m)	Maximum Longitudinal Brace Spacing, ft (m)
0.25	50 (15.2)	80 (24.4)
0.50	40 (12.2)	80 (24.4)
1.0	40 (12.2)	80 (24.4)
2.0	20 (6.1)	40 (12.2)

Table 8-4 PVC or PVDF Pipe with Solvent-Welded Connections

Maximum Seismic Acceleration Input (g)	Maximum Transverse Brace Spacing, ft (m)	Maximum Longitudinal Brace Spacing, ft (m)
0.25	25 (7.6)	40 (12.2)
0.50	20 (6.1)	40 (12.2)
1.0	20 (6.1)	40 (12.2)
2.0	10 (3.0)	20 (6.1)

Table 8-5 No-Hub Pipe with Shield and Clamp Connections

Maximum Seismic Acceleration Input (g)	Maximum Transverse Brace Spacing, ft (m)	Maximum Longitudinal Brace Spacing, ft (m)
0.25	25 (7.6)	40 (12.2)
0.50	20 (6.1)	40 (12.2)
1.0	20 (6.1)	40 (12.2)
2.0	10 (3.0)	20 (6.1)

The arrangement of the brackets along the lines must be defined based on the actual stiffness of the braced elements. Additionally, an adequate distribution of the brackets must be provided to avoid torsional and deformative effects on the braced elements that could compromise their functionality. It is suggested to place seismic brackets at the beginning and end of each straight section and at each change of direction of the system line. As an example, Figure 1 shows a positioning example:

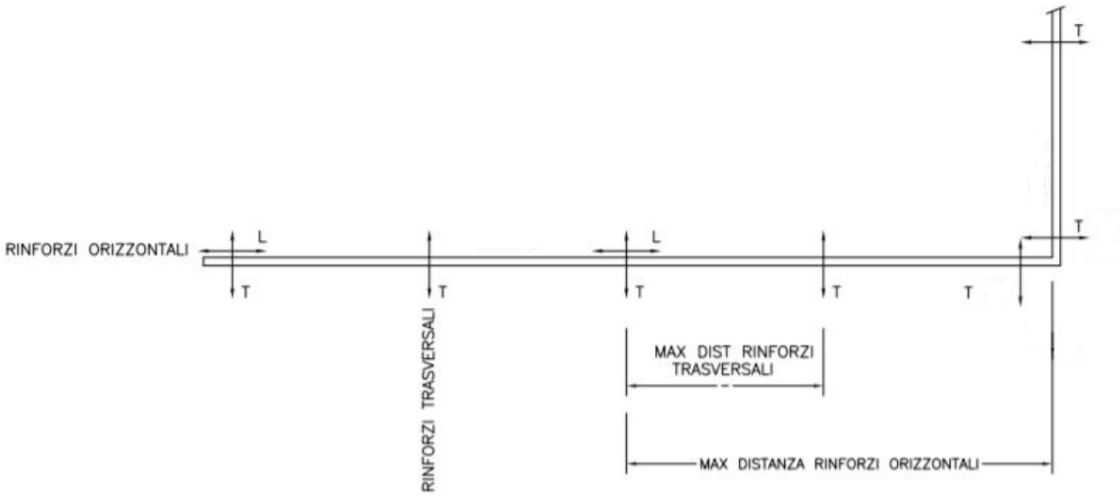

Figure 1 - Example of Bracing Arrangement

2.2.6.4. Testing and Certifications

ETA-98/0001 evaluation and CE marking for seismic mechanical anchor for applications on cracked and uncracked concrete for static and seismic loads in high seismicity (ETA C2) for applications on holes made by rotary percussion.

ETA-13/1038 evaluation and CE marking for screw anchor for applications on cracked and uncracked concrete for static and seismic loads in high seismicity (ETA C2) for applications on holes made by rotary percussion.

Execution of in-situ tests with a tester to determine the quality of the application of anchors fixed on concrete support through non-destructive tests, in accordance with BS guidelines. Tests must be performed on a number ≥ 5% of the total installed anchors with a minimum number ≥ 3. The testers or similar devices must be equipped with an appropriate displacement sensor and spacer support. The service must provide suitable documentation accompanied by load-displacement graphs and photographic survey.

2.2.6.5. Seismic-Resistant Support System for Ventilation Systems

Construction features

The bracing will consist of modular systems for medium-heavy applications.

The rails used must be made of S250 GD steel according to EN 10326, with a ribbed C-section, with serrated edges to facilitate engagement with the mounting bolts and protected by a 20-micron thick sendzimir galvanization. All necessary connecting elements must be made of S235 JR steel according to EN 10025, made from 4 mm thick sheet metal with a 13-

micron thick sendzimir galvanization. The attachment of accessories (angles, rail bases, etc.) to the installation system rails must be done using a universal zinc-plated connecting bolt, with an M10 screw in class 8.8 steel and a pre-assembled hammerhead with internal knurling to allow engagement on the bending of the C-profiles and to ensure tensile and shear resistance.
The transverse and longitudinal seismic bracing will be made using:

- Seismic angle, made of S275JR steel according to EN 10025-2, made from 4 mm thick sheet metal, with side fins with a 10.5 mm diameter circular hole to allow the attachment of seismic hinges for bracing made with rails or threaded rods. The angle is slotted with "butterfly" holes to allow engagement with C-profiles using universal connecting bolts for installation systems; it is provided with a side bend and a front tooth that improve the connection with the C-mounting rail. The angle is completed with a U-shaped reinforcement bracket that wraps around the underlying longitudinal mounting rail and is fixed to the angle through two M10x25 screws in class 8.8 steel and two M10 nuts in class 8.8 steel.
- Seismic hinge type MQS-AC pre-assembled in S275 JR steel according to EN 10025. Consisting of two parts: the upper part, 4 mm thick, has one or two 35x19 mm "butterfly" slotted holes to allow engagement with C-profiles using universal connecting bolts; the lower part, 6 mm thick, has a circular hole (diameter 11.5 mm or 13.6 mm) and is connected to the upper part through an M10x25 screw in class 8.8 steel and an M10 nut in class 8.

Fastening system

Supply of mechanical screw anchors for fastening structural steel elements to concrete for applications with reduced thicknesses and/or edge distances and/or spacings, which must have CE marking and ETA evaluation, in seismic category C2 for seismic-resistant supports. Supply of seismic mechanical anchors for fastening structural steel elements to concrete for applications with reduced thicknesses and/or edge distances and/or spacings. The mechanical anchor must have CE marking and ETA evaluation, in seismic category C2. The hole should be made using rotary percussion or coring or with automatic drilling systems. The annular space between the anchor and the hole can be filled using the seismic filling set.

Positioning and Installation Criteria

Seismic bracing spacing according to "SMACNA" - Seismic Restraint Manual for Mechanical Systems. For ventilation systems, an excerpt from the aforementioned manual is provided:

II. Transverse bracing shall be provided at 30 ft. maximum spacing for ducts conforming to SMACNA standards.

III. Longitudinal bracing shall be provided at 60 ft. maximum spacing for ducts conforming to SMACNA standards.

IV. Fiberglass, Plastic or other duct constructed of non-ductile material, shall have the brace spacing reduced to one-half of the maximum spacing for transverse and longitudinal braces listed above.

The arrangement of the brackets along the lines must be defined based on the actual stiffness of the braced elements. Additionally, an adequate distribution of the brackets must be provided to avoid torsional and deformative effects on the braced elements that could compromise their functionality. It is suggested to place seismic brackets at the beginning and end of each straight section and at each change of direction of the system line.

Figure 2 shows a positioning example:

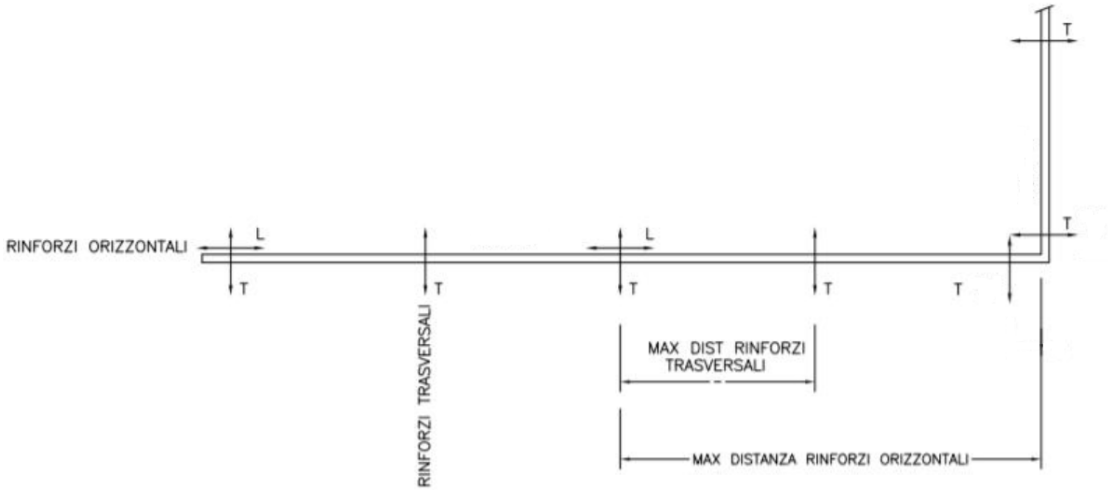

Figure 2 – Example of Bracing Arrangement

Testing and Certifications

ETA-98/0001 evaluation and CE marking for seismic mechanical anchor for applications on cracked and uncracked concrete for static and seismic loads in high seismicity (ETA C2) for applications on holes made by rotary percussion.

ETA-13/1038 evaluation and CE marking for screw anchor for applications on cracked and uncracked concrete for static and seismic loads in high seismicity (ETA C2) for applications on holes made by rotary percussion.

Execution of in-situ tests with a tester to determine the quality of the application of anchors fixed on concrete support through non-destructive tests, in accordance with BS guidelines. Tests must be performed on a number ≥ 5% of the total installed anchors with a minimum number ≥ 3. The testers or similar devices must be equipped with an appropriate displacement sensor and spacer support. The service must provide suitable documentation accompanied by load-displacement graphs and photographic survey.

2.2.6.6. Seismic-Resistant Support System for Fire Protection Systems

Construction features

The bracing will consist of modular systems for medium-heavy applications.
The piping must be supported by suitable pipe hooks (pear clamps) made of galvanized sheet metal with a thickness of 1.5 to 2.5 mm, with quick coupling and FM approval, in galvanized steel DX51D Z275 according to DIN EN 10327, or by clamps made of galvanized steel S235JRG according to DIN EN 10025, internally threaded, suitable for inserting threaded rods.

Horizontal loads must be supported by clamps made of galvanized steel S235JRG according to DIN EN 10025 or by suitable clamps made of galvanized steel S235 JR according to DIN EN 10025 or galvanized steel DD11 according to DIN EN 10111.

The transverse and longitudinal seismic bracing will be made using threaded rods and seismic hinges in electrolytically galvanized steel S275JR according to DIN EN 10025.

If used, the rails must be made of S250 GD steel according to EN 10326, with a ribbed C-section, with serrated edges to facilitate engagement with the mounting bolts and protected by a 20-micron thick sendzimir galvanization.
All necessary connecting elements must be made of S235 JR steel according to EN 10025, made from 4 mm thick sheet metal with a 13-micron thick sendzimir galvanization. The attachment of accessories (angles, rail bases, etc.) to the installation system rails must be done using a universal zinc-plated connecting bolt, with an M10 screw in class 8.8 steel and

a pre-assembled hammerhead with internal knurling to allow engagement on the bending of the C-profiles and to ensure tensile and shear resistance.

Fastening System

Supply of mechanical screw anchors for fastening structural steel elements to concrete for applications with reduced thicknesses and/or edge distances and/or spacings, which must have CE marking and ETA evaluation, in seismic category C2 for seismic-resistant supports.

Supply of seismic mechanical anchors for fastening structural steel elements to concrete for applications with reduced thicknesses and/or edge distances and/or spacings. The mechanical anchor must have CE marking and ETA evaluation, in seismic category C2. The hole should be made using rotary percussion or coring or with automatic drilling systems. The annular space between the anchor and the hole can be filled using the seismic filling set.

Positioning and Installation Criteria

Seismic bracing spacing according to "Guidelines for the reduction of seismic vulnerability of fire protection systems":

Tabella B2. Distanza tra le controventature (valori consigliati se non diversamente determinati)

Diametro nominale	Distanza massima fra le controventature		
	trasversali		longitudinali
	per tubazioni in acciaio (m)	per tubazioni in rame (m)	qualsiasi materiale (m)
DN 20	-	4.3	12
DN 25	8.5	4.3	
DN 32	9.0	4.5	
DN 40	9.3	4.7	
DN 50	10.8	5.4	
DN 65	12.0	6.0	
DN 80	12.9	6.5	
DN 100	14.7	7.4	
DN 125	15.3		
DN 150	16.8		
DN 200	20.4		
DN 300	22.0		

The arrangement of the brackets along the lines must be defined based on the actual stiffness of the braced elements. Additionally, an adequate distribution of the brackets must be provided to avoid torsional and deformative effects on the braced elements that could compromise their functionality. It is suggested to place seismic brackets at the beginning and end of each straight section and at each change of direction of the system line.
As an example, Figure 3 shows a positioning example:

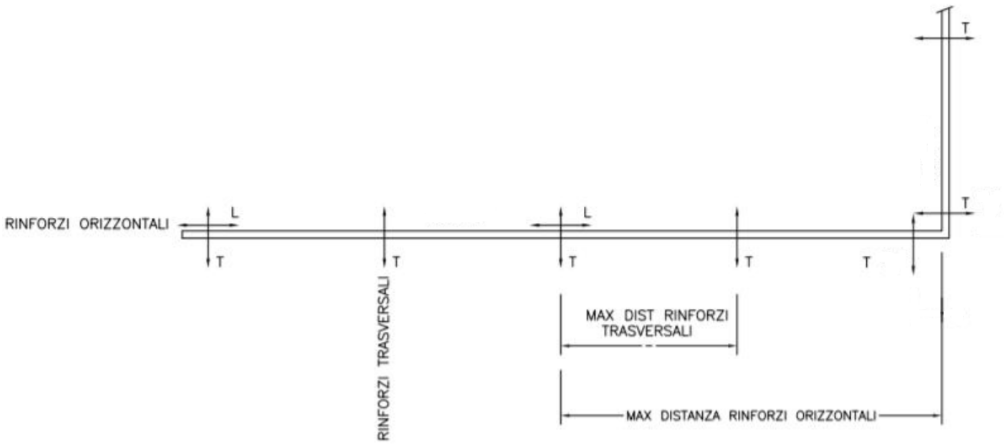

Figure 3 – Example of Bracing Arrangement

Testing and Certifications

ETA-98/0001 evaluation and CE marking for seismic mechanical anchor for applications on cracked and uncracked concrete for static and seismic loads in high seismicity (ETA C2) for applications on holes made by rotary percussion. ETA-13/1038 evaluation and CE marking for screw anchor for applications on cracked and uncracked concrete for static and seismic loads in high seismicity (ETA C2) for applications on holes made by rotary percussion. Execution of in-situ tests with a tester to determine the quality of the application of anchors fixed on concrete support through non-destructive tests, in accordance with BS guidelines. Tests must be performed on a number ≥ 5% of the total installed anchors with a minimum number ≥ 3. The testers or similar devices must be equipped with an appropriate displacement sensor and spacer support. The service must provide suitable documentation accompanied by load-displacement graphs and photographic survey.

2.2.6.7. Seismic-Resistant Support System for Sprinkler Systems

Construction features

The bracing will consist of modular systems for medium-heavy applications. The piping must be supported by suitable pipe hooks (pear clamps) made of galvanized sheet metal with a thickness of 1.5 to 2.5 mm, with quick coupling and FM approval, in galvanized steel DX51D Z275 according to DIN EN 10327, internally threaded, suitable for inserting threaded rods. The transverse and longitudinal seismic bracing will be made using an FM-approved seismic support system for sprinkler systems, appropriately braced both longitudinally and transversely through the system: horizontal loads must be supported by clamps and hinges for longitudinal and transverse bracing in S275JR steel according to DIN EN 10025. Hinges and clamps will be in S275JRJ steel according to DIN EN 10025 with electrolytic galvanization, connected with rails in S250 GD steel according to EN 10326, with a ribbed C-section, with serrated edges to facilitate engagement with the mounting bolts and protected by a 20-micron thick sendzimir galvanization. The attachment of accessories (angles, rail bases, etc.) to the installation system rails must be done using a universal zinc-plated connecting bolt, with an M10 screw in class 8.8 steel and a pre-assembled hammerhead with internal knurling to allow engagement on the bending of the C-profiles and to ensure tensile and shear resistance.

Fastening System

Supply of mechanical screw anchors for fastening structural steel elements to concrete for applications with reduced thicknesses and/or edge distances and/or spacings, which must have CE marking and ETA evaluation, in seismic category C2 for seismic-resistant supports. Supply of seismic mechanical anchors for fastening structural steel elements to concrete for applications with reduced thicknesses and/or edge distances and/or spacings. The mechanical anchor must have CE marking and ETA evaluation, in seismic category C2. The hole should be made using rotary percussion or coring or with automatic drilling systems. The annular space between the anchor and the hole can be filled using the seismic filling set.

Positioning and Installation Criteria

Static bracing spacing according to the reference guidelines: FM data sheet 2-0

Table 24. Maximum Distance Between Pipe Hangers

Piping Material	*Maximum Horizontal Distance Between Pipe Hangers, ft (m)*								
	Nominal Pipe Diameter, in. (mm)								
	1 (25)	1-¼ (32)	1-½ (40)	2 (50)	2-½ (65)	3 (80)	3-½ (90)	4 (100)	> 4 (> 100)
Steel Pipe[1]	12 (3.6)	12 (3.6)	15 (4.5)	15 (4.5)	15 (4.5)	15 (4.5)	15 (4.5)	15 (4.5)	15 (4.5)
CPVC[2]	6 (1.8)	6-½ (1.95)	7 (2.1)	8 (2.4)	9 (2.7)	10 (3.0)	N/A	N/A	N/A

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Table 9.2.2.1(b) Maximum Distance Between Hangers (m)

	Nominal Pipe Size (mm)											
	20	25	32	40	50	65	80	90	100	125	150	200
Steel pipe except threaded lightwall	NA	3.7	3.7	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Threaded lightwall steel pipe	NA	3.7	3.7	3.7	3.7	3.7	3.7	NA	NA	NA	NA	NA
Copper tube	2.4	2.4	3.0	3.0	3.7	3.7	3.7	4.6	4.6	4.6	4.6	4.6
CPVC	1.7	1.8	2.0	2.1	2.4	2.7	3.0	NA	NA	NA	NA	NA
Ductile-iron pipe	NA	NA	NA	NA	NA	NA	4.6	NA	4.6	NA	4.6	4.6

NA: Not applicable.

Seismic bracing spacing according to the reference guidelines NFPA13, FM data sheet 2-8, approximately every 12 m for transverse bracing and every 24 m for longitudinal bracing. As an example, Figure 1 shows a positioning example according to NFPA 13 guidelines:

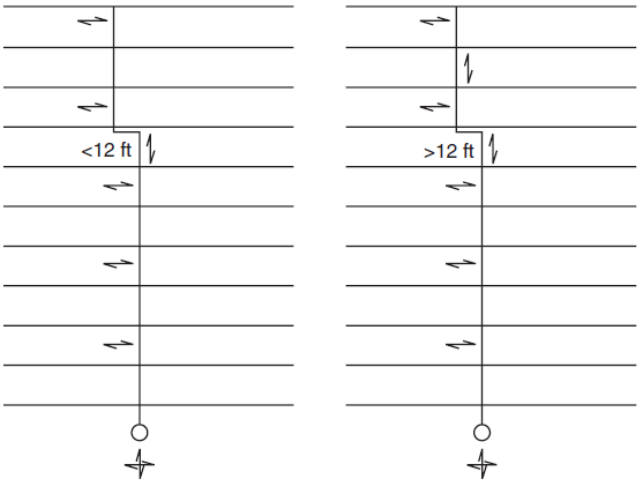


FIGURE A.9.3.5.7.2 Examples of Brace Locations for Change in Direction of Pipe.

Testing and certification

ETA-98/0001 evaluation and CE marking for seismic mechanical anchor for applications on cracked and uncracked concrete for static and seismic loads in high seismicity (ETA C2) for applications on holes made by rotary percussion. ETA-13/1038 evaluation and CE marking for screw anchor for applications on cracked and uncracked concrete for static and seismic loads in high seismicity (ETA C2) for applications on holes made by rotary percussion. Execution of in-situ tests with a tester to determine the quality of the application of anchors fixed on concrete support through non-destructive tests, in accordance with BS guidelines. Tests must be performed on a number ≥ 5% of the total installed anchors with a minimum number ≥ 3. The testers or similar devices must be equipped with an appropriate displacement sensor and spacer support. The service must provide suitable documentation accompanied by load-displacement graphs and photographic survey.

2.2.7. Pipe Spacing

Pipes shall be spaced in relation to one another and to the building structure so as not to interfere with any other services and to allow for the required method and thickness of the thermal insulation as specified. Clearance between pipework

(both insulated and uninsulated) and finished walls, floors, ceilings and other fixtures shall be adequate for cleaning purposes, future dismantling, etc. and shall not be less than the distance given below (excludes flanges and unions):

- Pipework to pipework Minimum distance: 50 mm
- Insulation to insulation Minimum distance 50 mm
- Pipework to floors Minimum distance 100 mm
- Pipework to ceilings Minimum distance 100 mm
- Pipework to walls Minimum distance to conform with standard bracket centres with due allowance made for thermal insulation.

The spaces indicated above shall be achieved irrespective of the insulation thickness used.

All exposed pipe runs shall be arranged to present a neat appearance and be parallel both with one another and with the building structure taking due regard however to the grading, venting and draining requirements. All vertical pipes shall be plumb. All pipe runs shall be arranged so that the longest length of tube practicable is used between bends, tees and flanges or unions. Short lengths of tube joined together by sockets or flanges shall not be employed.

2.2.8. Access to valves

To facilitate routine maintenance, the positions of all valves, vents, filters, drains, and supports, etc., must be determined with this aspect in mind. Grouping valves, drains, fittings, filters, flanges, etc., is preferable to scattered placement. All piping, valves, fittings, and equipment must be mounted in such a way that they can be disassembled and accessed for repair, maintenance, and replacement.

In this context "accessible" means that the provision for dismantling the flange, union, etc., can be reached and worked upon either in the open or else by removal of a purpose-made duct cover, manhole or similar cover. No joints shall be formed within the thickness of walls, floors or ceilings. Unions or flanges shall be provided generally at a maximum spacing of one per twelve metres, in agreed positions.

Piping must have welded joints and fittings where they are located:

1. In a floor duct
2. Above inaccessible suspended ceilings
3. In the main riser positions
4. In the riser duct with limited access
5. In all situations where it is not fully accessible for regular inspection of the entire joint.

On concealed pipework, if screwed joints to air vents, drain cocks and pressure gauges are used, then full access shall be provided to allow future complete inspection, dismantling, removal, replacement and re-jointing.

2.2.9. Floor ducts

Where pipework conveying water is to be concealed within the floor screed it shall be installed in a purpose-made galvanised sheet metal floor duct, or as detailed on the drawings. The ducts shall be installed at a level, which allows the cover to finish flush with the rest of the floor.

Ducts shall be fixed to prevent movement during screeding and joints sealed with waterproof tape. Where ducts pass through fire barriers they shall be adequately stopped. After pressure testing, insulation and commissioning the duct covers shall be fixed down. Fixings shall be removable to allow for subsequent removal of the cover, if necessary.

2.2.10. Pipe sleeves

In all cases where pipes pass through walls, floors, ceilings and footings, sleeves shall be provided and it shall be ensured that the sleeves are correctly built-in. Sleeves shall in no case be used as pipe supports, a free annular space. always being provided. Puddle flanges shall be provided on pipework passing through walls and intended to be covered by earth, etc., or where passing through bund walls. Sleeves shall be of pipe cuttings properly reamed, cleaned and trimmed at 90° to bore.

Sleeves in loadbearing walls or footings shall be cast iron pipe. Sleeves in non- loadbearing walls, floors, ceilings and partitions shall be in copper or mild steel or high impact plastic to suit the particular pipe materials.

Flashing sleeves shall be provided, as required, except where indicated otherwise. They shall incorporate an integral flange to which a flashing shield can be clamped or welded. The shield will be built into the membranes and the space between the sleeve and pipe will be filled with mineral wool fire stopping and finishing externally in high temperature mastic compound.

Inside diameter of sleeves shall be not less than 12 mm larger than the outside diameter of the pipe, except where pipes pass through loadbearing walls or footings where sleeves shall be 100 mm larger than the outside diameter of the pipe.
For pipes which change direction, oversize sleeves, the size larger than normal shall be fitted to allow for expansion.

The space between the pipe enclosed and its sleeve shall be caulked with mineral wool fire stop and intumescent mastic seal on each side of the sleeve.
Sleeves shall not protrude from the finished face of walls. In toilets, kitchens and all other situations where the floor may be swilled, the sleeves shall project 30 mm above the finished floor level.

Cold water pipework shall be provided with sleeves of such size as to allow the thermal insulation, at the full thickness, to pass through whilst maintaining the continuous vapour seal. The type of insulation shall become mineral wool with vapour seal for the thickness of wall in these instances.
Overflows shall have splay cut ends.
Cast iron shall be wrapped in two coats of Denso tape passing through walls or floors.

2.2.11. Fire sleeves

When pipes pass through a fire barrier, they must be equipped with fire protection devices that comply with current regulations. For insulated pipes, the unit must provide the same thickness of insulation used on both sides of the barrier. The insulation and any vapor barrier must be continuous. For exposed pipes, the fire protection system must have sufficient insulation thickness to accommodate movement due to expansion. Alternatively, for bare pipes, special fire sleeves must be installed.

The space between the pipe and its sleeve must be completely sealed using fire-resistant mineral wool and intumescent sealant on each side of the sleeve to a minimum depth of 15 mm.

Specially made fire sleeves must include a single piece of mild steel sheet with closure plates and slots that allow it to wrap around the pipe. Each end of the sleeve must be fitted with intumescent foam with a minimum thickness of 10 mm. The sleeves must be of the correct length to fit the structure and must be securely cemented. The sleeves must have a minimum resistance of 4 hours when tested in accordance with the DM 15 March 2005 "Fire reaction requirements of construction products installed in activities regulated by specific technical fire prevention provisions based on the European classification system". The sleeves must be made of materials that do not emit smoke or toxic fumes.

2.2.12. Floor/wall plates

Where exposed to view, pipes and tubes passing through walls, floors, ceilings, partitions and false ceilings of occupied rooms shall be fitted with a heavy chromium-plated die-cast zinc alloy masking plate. Such plates shall be split on the diameter, be snug fit to the pipe concerned and provided with countersunk holes for set screws.

2.2.13. Air venting

Full provisions shall be made for air venting of the systems, whether or not indicated within the project documents.
All exposed air bottles, automatic vents and drip pipes where required shall be properly insulated and protected against frost.
Air vents shall be provided at all high points in the pipework. They shall be installed at the highest point of the sections which they are intended to vent.
On all non-domestic systems air collection shall be by means of air collection bottles of the size shown within the Table below.

Pipe Size (mm)	Air Bottle Bore Pipe (mm)
Up to 40	50
50 to 80	50
100 and above	100

All shall be 250 mm long with welded end caps and be complete with 15 mm copper pipe brought down from the top of the air bottle to within reach of ground floor level and fitted with 15 mm lockshield valve complete with key. The final vertical piece of vent pipework will be kept as short as possible.

Tops of risers shall be continued as full bore air bottles for a minimum of 150 mm. They shall be constructed as described above. Each such air bottle shall be provided with a manual air vent with a minimum size of 25 mm for use in connection with system flushing.

Where the air bottle or pocket is not readily accessible, a 15 mm bore air release pipe shall be provided from each bottle or pocket. This shall be arranged to terminate in a position of easy access at approximately one metre above floor or ground level; or immediately above a ceiling tile where provided in suspended ceilings; or at such level as may be required by the engineer.

Where possible, terminations shall be grouped for convenient access. Each termination shall be provided with a label complying with the requirements of this Specification which identifies the service to which the termination applies.

On low or medium temperature pipework the air release pipe shall be fitted with a 6 mm needle seated key-operated cock. On high temperature pipework it shall be fitted with a 10 mm needle seated globe valve arranged for key-operation and fitted with a sunken plug.

Automatic air vents shall be used where required and shall have gunmetal bodies with not less than 15 mm connections, copper or stainless-steel floats, guides and non-corrodible needle valves.

In all cases the air vent shall be protected by a lockshield pattern stop valve and the discharge from the air vent shall be 15 mm copper pipe, which shall be run to discharge over an agreed gully, sump or other position.

On high pressure water pipework systems, the vent pipework shall finish at a flanged valve, complete with blank flange. Automatic air vents shall not be used.

The pipes will be installed in such a way as to allow for the complete drainage of the circuits and the elimination of air.

2.2.14. Draining of system

The pipes will be installed in such a way as to allow for the complete drainage of the circuits and the elimination of air.

Discharges from equipment (tanks, chillers, safety valves, pumps, etc.) and pipes will be directed to the nearest inspectable drainage pits, which the Contractor will provide upon timely indication from the equipment supplier. Discharges will be collected using collection funnels (unless otherwise advised by the temperature or pressure conditions of the fluid).
Drains for pipe drainage will be equipped with plug valves with gland packing or ball valves, suitable for the operating conditions of the fluid concerned, unless otherwise specified in the technical specification.

Drain points shall be provided on all items of plant, equipment and their component parts, at all low points of water services installations and also on the branch side of all main isolating valves and cocks whether or not indicated on the drawings.

Drain points shall be fitted with drain valve of gunmetal construction manufactured to the requirements of UNI EN ISO 898, complete with hose union and removable key.

Any equipment or component fitted with condensate trays, drains, overflows or discharge collection points, shall be provided with drain pipes extended to discharge over an agreed gully, sump or other position and be complete with HEPVO self-sealing valve and tundish as required.

On low or medium pressure systems drain cocks shall comprise standard hose union gland type drain cocks and detachable keys manufactured from cast gunmetal or bronze. On high pressure hot water systems they shall comprise a needle-seated key-operated globe valve. On open circuit systems they shall be screw-down for draining taps (screw-down pattern) . All drain cocks shall come complete with caps.

Drain and drip points at pumps, cooler coils, safety valves, safety cocks and other equipment shall be provided with drain lines discharging into tundishes adjacent to the equipment. Where necessary to prevent back suction, drains from equipment shall be fitted with cleanable traps of a depth such that the system pressure does not break the water seal.

Tundishes shall be sized for the expected discharge and shall be constructed from copper or stainless steel sheet. A rolled top rim shall be formed to stiffen the tundish and a hinged lid provided to allow for examination of the drip pipes without disturbing the drain lines. Tundishes shall discharge into pipes run to convenient floor gullies or sumps.

2.2.15. Gradient of Pipework

All pipework shall be installed with continuous gradients to allow for drainage and / or release of air, according to the service concerned. Gradients shall be generally as detailed within the Table below.

Service	Gradient
Mechanical Services Water Mains	25 mm in 12 m
Mechanical Services Water Branches	25 mm in 6 m
Gas, Compressed Air, Steam and Condensate	25 mm in 12 m

In occupied areas where services are exposed to view and venting and draining can be accommodated, such as run-outs to radiators, pipework may be run level.

2.2.16. Dirt pockets

Dirt pockets shall be installed at the base of all main pipework risers and on all heat transfer coils and at low points in plantrooms. The pocket shall be no less than 150 mm deep and the same size as the pipework.

The base of each dirt pocket on low temperature systems shall be provided with a lockable hose union ball valve. On high temperature systems the valve shall be as described above and be plugged.

2.2.17. Flushing points

Prior to final filling all systems shall be flushed through in order to remove all debris, etc.

In order to allow this procedure the contractor shall provide full bore flushing bypasses at all heat exchangers, at the end of main horizontal distribution runs and at all terminal units. The bypasses shall be provided with lockable isolation valves.

All flushing requirements shall be as set out in the relevant Black & White Engineering standard specification and the project documents.

When installing the pipework the contractor shall consider the needs for flushing and shall install suitable connection points for water supplies and drains for the flushing process.

2.2.18. Protective coverings

All ferrous materials including pipework, fittings, sundry iron and steel brackets shall be primed before despatch to site. Protective coatings removed or damaged shall be thoroughly wire brushed and cleaned before re-priming. All ferrous materials shall be applied with two coats of zinc-based oxide paint immediately after erection.

Pipework and fittings in ferrous and non-ferrous materials were buried underground or in trenches, etc., must be covered in "Denso" tape prior to being insulated and backfilled.

All external pipe brackets and support steels shall be mild steel galvanised after manufacture at the works. The assembly on site shall in no way deteriorate the quality of the galvanising.

All flange nuts, bolts and washers sited externally shall be stainless steel. The Contractor shall provide all necessary weathering where pipework passes through the roof, etc., including aprons to suit the upstands.

2.2.19. Protection of open ends and threads

All open ends and threads of installed or pre-fabricated pipework shall be protected by use of appropriate dimensioned temporary plastic end caps or end plugs. For pipework in the process of being install and fabricated on-site this shall apply to any open end that will not be extended with the next 24 hours.

2.2.20. Electrical bonding continuity

The contractor shall ensure that earth continuity is maintained throughout all installations. The form of electrical continuity shall not fortuitous and shall require the installation of electrical bonding straps.
The arrangements for electrical bonding continuity and for connection to the electrical earthing system shall meet the requirements set out with Black & White Engineering standard specifications and the project documents.

2.2.21. Speed

Water service distribution pipes must be designed and installed to operate between 1.0 and 1.5 m/sec for copper or steel, and between 1.0 and 2.0 m/sec for plastic.

2.2.22. Pipework insulation coding

Pipework insulation coding shall be as called for in this Specification.
Pipework not insulated shall be painted by the contractor, unless stated otherwise, after completion of the installation (including brackets, fittings and accessories on the pipeline) to be correct colour code in adherence to UNI 5634.

2.2.23. Testing

The contractor shall include all costs, fees and programming for the cutting open of any ten sections of pipework for inspection. The engineer reserves the right to instruct this work at any reasonable time in the programme

2.2.24. Expansion and contraction

The Contractor shall supply and install all equipment necessary for the safe expansion and / or contraction of pipework.

The setting out of pipework shall take into account any natural flexibility of the pipework. Attention shall be given to the detailed arrangement of supports, branch connections and restraints imposed by structure or other services. Where the natural flexibility of the pipework is insufficient, the expansion shall be taken up with expansion bellows, joints, compensators or loops. Pipework shall be anchored and guided in accordance with the manufacturer's recommendations.

Where bends and loops are not a practical solution, provision for expansion shall be by the insertion of stainless steel expansion bellows, flanged or screwed, as required. Expansion bellows shall be located and installed to the requirements of the bellows manufacturer.

The contractor shall be responsible for ensuring whether specifically indicated or not that the installation shall include all requirements, loops, bellows, etc., necessary to alleviate any distortion, movement of joints, etc. as a result of expansion and /or contraction of the system.

2.2.24.1. Expansion loops

Expansion loops or bends shall be one-piece and made at the tube or fitting manufacturer's works. If the total length of tube in the loop or bend is such as to prohibit this, welds may be made in the long arms as near the centre as possible. No welds will be permitted in the crown of the bend or in the short arms and any seams shall be arranged as the side of the bends. Loops or bends shall be flanged and arranged to vent and drain naturally.

Expansion loops shall be erected with cold draw to half the total calculated expansion to be absorbed by the loop. Care shall be taken to ensure that all cold draw allowances are observed and that no slip occurs at the anchors.

2.2.24.2. Expansion bellows

Expansion bellows and joints shall be installed in the pipework to absorb the axial movement of the pipelines.

Where single and double expansion bellows are installed, these shall have joints as the pipework, as recommended by the manufacturer.

Care shall be taken when installing flanged end bellows to line up the bolt holes on joint and mating flanges and to ensure that the joint is not twisted in any way or any torsional stresses applied.

The bellows shall be installed with due allowance having been made for cold draw which will vary according to the type and length of bellows proposed and the temperature of installation. Where "installation bars" or fittings are incorporated with the bellows during delivery and erection, these must be removed before heat is applied.

The manufacturers' installation instructions shall be complied with in all respects.

2.2.24.3. Guides

A minimum of two guide sleeves shall be fitted on each side of the expansion joint, unless such joint be installed adjacent to an anchor point, when guides shall be fitted on the free side only.

Guides shall consist of sleeves or framework rigidly fixed, but permitting axial pipe movement while restraining the pipe from radial movement. Guides shall have a clearance of not more than 3 mm between the outer surface and the inner surface of the guide and shall be as detailed within the Table below.

Pipe Size (mm)	Length (mm)
Up to 32	75
40 to 125	130
150 and above	230

Guides shall be installed not more than four pipe diameters from the expansion joint to the first guide and not more than fourteen pipe diameters between this guide and the next.

2.2.24.4. Pressure testing

When pressure testing pipework distribution the test pressure shall exceed 1,5 times the maximum operating pressure and temporary spacer pieces shall be installed as necessary and shall remain for the duration of the tests.

2.2.24.5. Branches

Branch connections are to be taken from the top or bottom of both flow and return mains depending on air venting requirements. Branches shall incorporate in at least two bends before passing into sub-ducts, trenches, vertical risers or chases, etc. The bends shall be so arranged as to take up the expansion of the mains without putting any strain on the length of the branches.

2.2.24.6. Drawings

The contractor shall prepare drawings detailing the proposed location of all guides in relation to the anchor locations, together with full fabrication details of the anchors, proposed method of supports, fixings, etc.
The drawings / details shall be submitted to the engineer prior to commencement of any fabrication / installation works.

2.2.24.7. Anchor points

Mild steel anchors shall be installed to resist the maximum stresses of the pipework. The anchor shall be fixed to heavy steelwork or main brick walls or approved concrete structure only. The anchors shall consist of heavy section iron "U" straps welded to the pipework and attached to the supports by nuts and bolts. Where fixed to brickwork, short channel irons shall be attached to the wall to obtain a fixing for the "U" straps.

The contractor shall provide all cleats, brackets and steelwork required for building in, as necessary.

Details of all anchors and associated builders' work shall be submitted, by the contractor to the engineer, before manufacture, together with calculations of thrust loadings.

2.3. Valves and hydraulic accessories

2.3.1. General

All valves should, as far as possible, be of the same manufacture and style to provide uniformity of appearance and simplify maintenance.

All valves fitted to water services installations shall comply with Italian Standards requirements.

Each installed valve must have a label indicating the nominal pressure, diameter, and product code.

In addition to valves shown on the drawings, the contractor shall include for the installation of sufficient valves and strainers, to satisfy the engineer that the following facilities will be available:

1. Regulation of hot water system.
2. Regulation of cold water system.
3. Isolation of distribution branch pipework of hot and cold-water systems.
4. Isolation of appliance or pipeline equipment for maintenance.
5. Check valves where plant must operate on automatic changeover, or where reversal of flow may occur, or backflow prevention.
6. Drain points for the complete removal of water from the system.
7. Air vents for the complete removal of air from the system.
8. Relief mechanisms for the protection of plant and equipment.

Each valve shall be approved to a UNI EN ISO 9001.

Valves and cocks shall be provided to permit the isolation of equipment or sections of the installation and for balancing and regulation of flow quantities.

Valves and cocks on critical services or where unauthorised interference is possible shall be tamperproof. This shall either be achieved by lockshield cover, tamperproof cover or padlock on larger valves.

As far as is practical all valves on a specific project shall be supplied from the same manufacturer and in the same style in order to provide uniformity of appearance and ease of maintenance.

All valves and cocks shall be manufactured from non-dezincifiable materials and selected to suit the pipeline to ensure no electrolytic action takes place.

ll valves used must be of a brand and type approved by the Work Supervision and must ensure excellent sealing over time, even with infrequent operations.

All valves used and special parts must be painted according to the same methods indicated for the pipes, or tarred hot if buried.

The nominal pressure (PN) of the valves must be in accordance with the prescriptions of the related pipes.

All threaded valves must be mounted with a three-piece union to allow easy disassembly.

The levers or operating mechanisms must allow closing or opening operations without damaging the insulation.

In general, valves with threaded connections up to 2", with flanged connections starting from DN 65; always with flanged connections on the manifolds; for pump connections, threaded connections up to 1 1/4", from DN40 flanged connections; for gas circuits, threaded valves up to 3".

Calibration valves must be identified with tags, showing the identification code indicated in the "as-built" drawings.

Switching valves must be identified with tags; the switching positions (summer-winter or other) must be clearly indicated.

Valves to be selected in ordet to guarantee concurrent maintainability of the system.

Body design: Lug type syitable for bidirectional dead-end service at rated pressure without use of downstream flange.

Dead end service at full rated pressure (100% PN).

The following is a general list of valves, stop valves and other fittings to be used. The contractor shall ensure that all valves, stop valves and other fittings used on a particular service are suitable for the temperatures, working pressures and substance carried within the service.

Valves for isolation

Valves for the isolation of hot and cold branch distribution pipework, major items of plant and pipeline equipment shall be non-dezincifiable copper alloy, lever handle ball valve.

Valves shall be installed where shown within the project documents and shall always be installed at the following locations:

1. At branch connections from distribution mains to allow isolation of all sub-circuits.
2. The base of all risers and drops.
3. Points of connection to all items of apparatus and equipment.
4. Draw-off fittings or floats on multiple fittings.

See schedule in the following tables.

Double regulating valve

Valves for the regulating and isolating of hot water service return.
See schedule in the following tables.

Stop Valves

Stop valves for the isolating of mains water fed equipment or apparatus shall generally comply with compliance with UNI EN 1213.
See schedule in the following tables.

Service valve

Ball type mechanism, screw driven or coin-operated for the isolation of WC cistern ball valves and appliances taps. Compression couplings.
See schedule in the following tables.

Double check valves

For the prevention of backflow occurrence between premises fed by common supply and appliances.
See schedule in the following tables.

Check Valves (Single Non-Return)

For pipework sizes 15 mm to 54 mm inclusive, check valves rated PN25, conforming to EN 13959 requirements having resilient renewable elastic seals.

For pipework sizes 65 mm and above, check valves shall be cast iron, swing type to UNI EN 12334 rated PN16, conforming to UNI EN 13959 requirements having resilient renewable elastic seals, flanged UNI EN 1092-1.
See schedule in the following tables.

Valves for draining

Valves shall be provided on all hydraulic systems to enable them to be fully drained. To this end they shall be specifically provided in the following locations:

1. At all plant and equipment including terminal units and valve sets.
2. At all system low points.
3. At the base of all risers.
4. At least one in each major section of pipework adjacent to the means of isolation.
5. All drain valves shall be provided with a hose union connector.

Drain taps

Drain taps on pipework to a range of fittings.
See schedule in the following tables.

Pressure reducing valves

For pressure boosted systems, pressure reducing valves shall be provided, as required. The water pressure shall be reduced down to fall within the pressure range required for the basin taps to be fitted.
See schedule in the following tables.

Automatic air vents

Size	Service	Reference
15 Screwed	Low pressure up to 95 °C	B
15 Flanged	High Pressure	F

Thermostatic Regulating Valves (DHW Return)

See schedule in the following tables.

Thermostatic Blending Valves

See schedule in the following tables.

Reduced pressure zone valve (RPZ valves)

See schedule in the following tables.

Float Valves (Excluding Waste Water Preventers)

Float valves sizes 1/2" (15 mm) to 2" (50 mm) shall be as the Aylesbury "K" type float valve as manufactured by Keraflo Limited having DZR brass body, polyethylene float and non-wearing ceramic disc for water pressure up to 10.0 bar. The contractor shall ensure that the valve is installed level and align.

Delayed Action Float Valves

Delayed action float valves sizes 1/2" (15 mm) to 2" (50 mm) shall be as the Aylesbury "KB" type float valve as manufactured by Keraflo Limited, having DZR brass body, polyethylene float, actuator to provide variable water level settings and non-wearing ceramic disc for water pressure up to 10.0 bar. The contractor shall ensure that the valve is installed level and align and that the actuator is set to the predetermined water level.

Air gaps
All feeds to water storage tanks must comply to Bye-Law 11, as laid down in the Water Supplies Bye-Laws Guide.

Radiator valves
Unless otherwise specified radiator valves on the flow connection shall be provided with a thermostatic head. These shall have a minimum or frost setting, have the facility to limit the adjustment range of the valve and have tamperproof covers and remote sensors where specified.

Return connections in all instances shall have lockshield pattern covers.

Safety valves
Automatic safety valves shall be provided on chillers, boilers, heat exchangers and all systems operating above atmospheric pressure including heating, hot and cold water, steam and compressed air systems. They shall be set to the latest HSE requirements and sized for the rated output of the appliance.

Valves shall be of the closed spring type and shall be marked with the set pressure and operating limit for which they were intended.

Discharge pipes shall always be provided at safety valves and shall be run to a safe position, preferably at low level and over a gully, sump or tundish.

Safety valves shall be lift type with screwed connections, to the size as indicated on the drawings with discharge set pressure as indicated on the drawings.

The safety valve shall satisfy the Italian standards requirements.

Pressure and temperature safety valves
Safety valves for the relief of excessive pressure and temperature shall be gunmetal lift type with screwed connections, to the size as indicated on the drawings.

The safety valves shall satisfy the requirements of italian standards requirements.

Temperature relief shall occur at a pre-set value of 96°C unless specified differently for a particular requirement detailed in the Project documentation.

Ball float valves
Float valves having DZR brass body, polyethylene float and non-wearing ceramic disc for water pressure up to 10.0 bar, hydraulic test according to UNI EN 1074-1 and 2 / UNI EN 12266. The contractor shall ensure that the valve is installed level and aligned.

Mounting and orientation
All valves and cocks shall be located to allow ease of maintenance and operation, ideally no greater than 2 m. Wherever possible valves shall be grouped, particularly where behind access panels.

At headers, where there is limited space between secondary pipes, the valves shall be staggered to allow ease of operation and application of insulation.

Orientation of valves shall always be strictly in accordance with the manufacturers' requirements.

Where valves are located externally particular care is required to ensure that water cannot affect valve operation. To this end valves should always be installed, wherever possible, with the spindle in the horizontal plane.

Test points on valves shall be orientated such that the test point is never mounted in a downward attitude.

Strainers

Strainers shall be fitted to all major pipework systems to arrest any circulating debris.

They shall be installed where detailed within the project documents and at the following specific locations:

1. At pump suction connections.
2. At items of plant or equipment with a particular sensitivity to debris at particle sizes smaller than the defined strainer standard.

Duplicate strainers are not generally required, but where system performance would be affected by maintenance a normally closed valved bypass shall be provided. Where duplicate pumps are provided, one strainer per pump without bypasses would be acceptable.

All strainers 50 mm and above shall be provided with pressure tappings.

Strainers 100 mm and above shall be provided with a differential pressure gauge with a red pointer indicating the clean pressure drop of the strainer and pressure sensing points, either side of strainer, for connecting a pressure sensor for BMS monitoring and alarm.

All strainers 100 mm diameter and above shall also be provided with a drain cock and hose union.

Strainers shall have stainless steel screens and for normal operation shall have a perforated strainer screen having openings of 0.8 mm.

During commissioning, however, the contractor shall replace these screens with a coarser mesh to arrest all construction debris. Before bringing into service the original screens shall be installed.

Strainers shall be installed on all suction pipework to pumping equipment downstream of main isolation valves to package equipment.

Fittings shall be of the "Y" type pattern with stainless steel elements having 0.8 mm perforations and shall be constructed from gunmetal with fibrous gasket and screwed cap with stainless steel rods and nuts for all pipework sizes up to and including 54 mm with ends threaded.

2.3.2. Valve identification

The contractor must provide and securely attach labels to all valves, identifying them in accordance with the schedules and drawings, indicating the reference numbers and the operation of each valve.

The labels must be made of Traffolyte and attached to the valve using chrome rings.

The valve schedule must be included as part of the manuals delivered to the owner.

Refer to the general contract specifications for further details on valve identification.

2.3.3. Isolating valve

2.3.3.1. Full Bore Ball Valves PN 16 - All Water Network Circuits up to 1 ½"

- Body in nickel-plated and chrome-plated brass OT58 UNI 5705-65. Ball in nickel-plated, chrome-plated, and diamond-coated brass OT58;
- PTFE ball seal;
- Stem seal with Viton O-ring and PTFE gasket;
- Socket connections, gas threaded;
- Plastic-coated steel lever with spacer bushing for insulated pipes;

2.3.3.2. Maintenance-Free Soft-Sealing Shut-Off Valves – Hot, Chilled, Condensation Water Circuits and Fan Coils up to DN 150

- Operating temperatures from -5°C to +120°C;
- Maintenance-free soft-sealing type;
- Body and cover cast in one piece of GG 25 cast iron;
- Non-rotating stainless steel stem with protected external thread;
- Stem seal with O-RING, 2 of EPDM and 2 of VITON;
- EPDM rubber stem back seal;
- Primary EPDM seal of the oblique seat type;
- Fixed handwheel;
- Position indicator, external to the insulation with locking possibility;
- UNI/DIN PN 16 flanges;
- Short face-to-face dimension DIN 3202/F4 - UNI 7125-72 flat series;
- External painting based on alkyd resins;
- For calibration valves, stop device and lift limitation;
- Complete with counter flanges, bolts, and gaskets;

2.3.3.3. Wafer Type Butterfly Valves PN 16 Single Flange - Chilled and Condensation Water Circuits over DN 150

- Body in ductile iron;
- Lens in PVDF-coated cast iron;
- Stainless steel stem with Teflon gasket;
- EPDM seal gasket;
- Cast iron operating lever with locking device;
- Complete with collar counter flanges, bolts, and gaskets;

2.3.3.4. Shut-Off or Control Valves with Internal Thread and Bellows Seal - Hot Water Circuits over DN 150

- Body and bonnet in ductile iron;

- Stainless steel stem;
- Stainless steel multi-lamellar bellows welded to a stainless steel support plate and valve cap;
- Stainless steel sealing seats;
- Graphite safety gland;
- Metal handwheel;
- Flange connections;
- Complete with counter flanges, bolts, and gaskets;
- For control valves, profiled plug with opening indicator and locking device;

2.3.3.5. Flat Body Gate Valves with Rubber Wedge and Internal Thread PN 16 - Sanitary Water Circuits from DN 50

- Body and cover in ductile iron;
- Stainless steel stem with O-Ring type sealing rings;
- Rubber-coated cast iron wedge;
- Internal and external painting with epoxy resins;
- Steel handwheel;
- Opening indicator for fire protection systems;
- Flange connections;
- Complete with counter flanges, bolts, and gaskets;

2.3.4. Regulating valves

2.3.4.1. Regulating valves PN 16 with Threaded Connections

- Bronze body;
- Teflon shutter seal ring;
- Nylon handwheel;
- Threaded socket connections;
- Complete with piezometric connections for measuring differential pressure between inlet and outlet and drain connection;
- Complete with preformed insulating shells and identification tag;

2.3.4.2. Regulating valves PN 16 with Flanged Connections

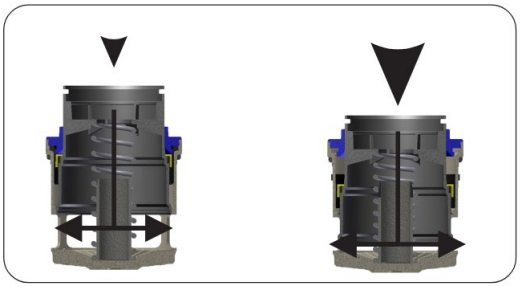
- Cast iron body;
- PFTE sealing seats;
- Aluminum handwheel;
- Flanged connections;
- Complete with piezometric connections for measuring differential pressure between inlet and outlet, counter flanges, bolts, and gaskets;
- Complete with preformed insulating shells and identification tag;

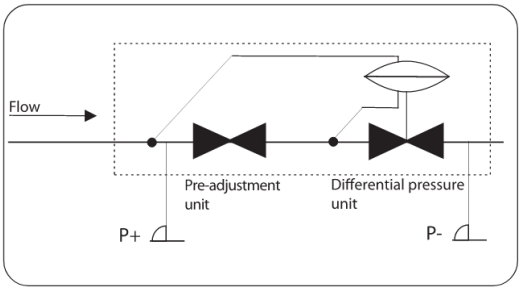
2.3.5. Pressure-Independent Flow Limiting Valves – Flanged Connections

The flow limiting valve, indipendently from the pressure, are made with specific cartridges integral part of the valve limiting the flow at the specified level even under fluctuating pressure conditions.

The design of these cartridges introduces a interchangeable orifice plate for design flexibility and a resistant diaphragm for high accuracy operation.

When the pressure increases the spring will be compressed and thereby the piston will reduce the outlet area and vice versa. The result is a constant flow rate through the valve, independent of pressure fluctuations.





The following applies to all flow control valves:

- Q = Kv * √Δp
- Q = Flow (m3/h)
- Kv = Opening area
- Δp = Differential pressure (Bar)

The cartridge reacts to pressure fluctuations in the system ensuring that the differential pressure across the pre-adjustment unit is kept constant. This ensures that the maximum flow limit is achieved in accordance with the design.

Flow Calculation
The flow through the valve can be identified by measuring the differential pressure (Δp) across the valve:
If the measured differential pressure is above the minimum Δp, the flow is the one stated on the graph for the valve.
If the measured differential pressure is below the minimum Δp, the flow can be found by using the formulas below.

Flow Calculation

$Q = Kv \cdot \sqrt{\Delta p}$	Q = m3/h Δp = Bar
$Q = Kv \cdot 100 \cdot \sqrt{\Delta p}$	Q = l/h Δp = kPa
$Q = \frac{Kv}{36} \cdot \sqrt{\Delta p}$	Q = l/s Δp = kPa

The valve has P/T plugs for differential pressure verification on the body.

Modifications & extensions of the system do not affect the hydraulic balance in the other parts of the system.

Tamper resistant cartridge independent of flow regulation errors during commissioning and operation of the system.
Resistant diaphragm between the moving parts of the cartridge eliminates friction, noise and impact from water hammer.
Heat treatment acc. to 02747 Part 2#4 a+b.
Pressure test acc. to EN12266.

Indication of flow rate on orifice plate
The four-digit number on the orifice plate is identical with the last four digits of the product code. The orifice can be identified by this number and the corresponding flow rate can be read from the flow rate tables.

Identification of cartridge
The three-digit number on the cartridge is identical with the first three digits of the product code. The cartridge can be identified by this number and the corresponding flow rate can be read from the flow rate tables.

Removal of orifice plate
The orifice plate can be removed by the special orifice-tool by sliding it in the grooves on the cartridge and back again. Then the orifice plate can be taken out. The orifice plate can be clicked back into the cartridge again.

Technical specifications of the valve:

- Valve housing: Nickel Aluminium Bronze
- EN 1982 CC333G-GS,
- B505 C95800
- P/T plugs: Nickel Aluminium Bronze
- EN 1982 CC333G-GS
- Fasteners: Duplex Steel
- Pressure class: PN16
- Temperature: -20°C to +50°C ASTM
- Flow range: 56 l/h - 1,584 m3/h
- Flange compliance: ANSI/ASME B16.5 / ISO 7005-2 / EN 1092-2

Technical specifications of the cartridge:

- Suitable for wafer: DN50 to DN450

- High Corrosion Resistance cartridge material: PPS glass-reinforced
- O-rings: EPDM 281
- Spring: Hastelloy C276 (high corrosion resistant)
- Diaphragm: HNBR reinforced
- Medium temperature: -20°C to +50°C (Seawater)
- Diff. pressure range: 47 - 600 kPa (max 300 kPa recommended)
- The valve shall comply with flanges according to ANSI/ASME B16.5 standards
- The pressure class for the valve housing shall be PN16
- The valve housing shall be made of Nickel Aluminium Bronze - EN 1982 CC333G-GC
- The valve shall contain pressure independent flow cartridges
- The valve shall operate up to a maximum differential pressure of 600 kPa
- The temperature medium (sea water applications) working range for the valve shall be -20°C to +32°C
- The valve shall be supplied with 1" PT plugs
- The PT plugs shall be made of Nickel Aluminium Bronze
- The fasteners shall be made of duplex steel
- The valve shall be fitted with the high corrosion resistance pressure independent flow cartridge
- The HCR cartridge for sizes DN50-DN800 shall be made of PPS glass-reinforced
- The HCR cartridge for sizes DN25 and DN40 shall be made of Super Duplex
- The flow rate should be defined by interchangeable orifice plate within the cartridge
- The cartridge diaphragm should be made of reinforced HNBR
- The cartridge O-rings should be made of EPDM
- The HCR cartridge spring shall be made of Hastelloy C276 stainless steel
- The cartridge spring shall be made of 1.4310 stainless steel

Modello di riferimento: Frese ALPHA HCR Wafer Flanged Connection.

2.3.6. PICV valves

Energy Valve - Control valve with electronic flow control, power and energy monitoring, sensor-regulated flow or power control, 2-way, PN 16 flange.

For modulating water flow in cooling and heating systems.

Composed of a ball control valve, actuator, measurement section with flow sensor, temperature sensors, and integrated monitoring function.
Communication via BACnet IP, BACnet MS/TP, Modbus TCP, Modbus RTU, and Belimo MP-Bus or conventional control.
Configurable via integrated web server or bus communication.

Data recording for 13 months.
Connection to proprietary Cloud.

Maximum flow rate (Vmax): 144…480 l/min, adjustable.

Torque: min. 20 Nm @ nominal voltage
Nominal voltage: AC 24 V, 50 Hz / DC 24 V
Control: Communicative control BACnet IP, BACnet MS/TP, Modbus TCP, Modbus RTU, MP-Bus Conventional control Positioning signal Y: DC 0…10 V
Operating range: DC 2…10 V (modifiable: DC 2…10 V)
Position feedback: DC 2…10 V, max 0.5 mA (modifiable: DC 0…10 V / DC 2…10 V)
Power consumption:
Operation: 7 W @ nominal torque
Rest position: 5 W
Performance: 6 VA

Connection:
Actuator: 1 m cable, 6 x 0.75 mm²
Running time: 90 s / 90 degrees
Manual operation: gear release with button Protection class: III low voltage protection Protection degree: IP54 EMC: CE compliant with 2014/30/EU

Fluids: cold and hot water
Water with max 50% glycol volume
Fluid temperature: -5…+120°C in the ball control valve
Construction: straight-way valve DN 65
Characteristic curve A-AB: equal percentage
Leakage rate A: tight closure (compliant with EN12266-1)
Connection: PN 16 flange
Allowable pressure ps: 1600 kPa
Theoretical kvs value: 50 m³/h
Closing pressure: 690 kPa
Differential pressure delta Pmax: 340 kPa
Rotation angle: 90 degrees
Safety function: In case of signal loss, the valve remains in the last known position.

Measurement principle: ultrasonic flow measurement
Flow measurement accuracy: +/- 6% (of 25…100% Vnom)
Control accuracy: +/- 10% (of 25…100% Vnom)
Minimum flow measurement: 1% Vnom

Absolute temperature measurement accuracy: +/- 0.6°C @ 60°C (Pt1000 EN60751 Class B) D
ifferential temperature measurement accuracy: +/- 0.23°K @ dT = 20 K

Permanent flow volume measurement.
Temperature measurement in supply and return flow.
Calculation of the current user power. Recording of user energy consumption.
Data recording function for all values for the last 13 months.
Configuration via integrated web server flow measurement section: EN-GJL-250 (GG25), with protective paint
Shutter: stainless steel AISI 316
Valve seat: PTFE, Viton O-ring
Stem seal: EPDM Well: non-stainless steel 316Ti

Brand: Belimo

Model: EV0xxF+BAC

2.3.7. Check valves

2.3.7.1. Reduced Length Check Valves

- Spring type;
- Wafer type for mounting between flanges, PN 16;
- Metal seal;
- Up to and including DN 100: body, seat, and guides in brass, spring retainer and spring in stainless steel;
- From DN 125 to DN 200: body, seat, and shutter in cast iron, spring in stainless steel;

2.3.7.2. Diaphragm Check Valves

- Venturi type;
- Cast iron body;
- Plastic or cast iron ogive. For drinking water, materials must comply with circular no. 102 M.S.;
- EPDM rubber diaphragm;
- Flange connections PN 10 and 16;
- Complete with counter flanges, bolts, and gaskets;

2.3.7.3. Venturi Type Check Valves PN 10

- Venturi type;
- Cast iron body;
- Steel spring;
- Hydrodynamic profile shutter with synthetic material seal in stainless steel;
- Bronze seat;
- Flange connections PN 10;
- Complete with counter flanges, bolts, and gaskets;

2.3.7.4. Swing Check Valves Threaded PN 10 (for horizontal installation only)

- Brass body and cover;
- Clapet type with hard rubber shutter;

2.3.7.5. Swing Check Valves PN 16 (for horizontal installation only)

- Cast iron body, cover, and swing;
- Rubber swing seal ring;
- Brass body seal seat;
- Flange connections;
- Complete with counter flanges, bolts, and gaskets;

2.3.7.6. Plug Check Valves - Straight Flow or Angle Threaded PN 10

- Brass body and cover;
- "Jenkins" type seal seats;

2.3.7.7. Plug Check Valves - Straight Flow or Angle PN 16

- Cast iron body and cover;
- Stainless steel seal seats;
- Stainless steel or carbon steel with stainless steel seal seats;
- Steel closing springs;
- Graphite gaskets;

2.3.8. Differential Bypass Valves

The differential bypass valve, suitable for variable flow heating and cooling systems, is equipped with a soft NBR diaphragm that ensures maximum durability over time and an auxiliary spring that opens the valve in case of diaphragm failure. Designed for easy intervention in confined spaces, it features a ductile iron body with electrophoretic coating to ensure maximum oxidation protection. The in-line design allows for high differential operating pressures without generating noise. The pneumatic spring allows the set-point to be fixed between 0 and 16 bar.

Technical features:

Applicazioni:
Impianti di riscaldamento e raffrescamento.

Funzioni:
Valvola di by-pass differenziale in linea con molla pneumatica.
Apertura all'aumentare della pressione in ingresso.

Dimensioni:
DN 15-125

Pressione nominale:
PN 25 o PN 16 (DN 100-125)

Pressione differenziale max. (ΔpV):
1 600 kPa = 16 bar

Campo di taratura:
0-16 bar

Temperatura:
Temperatura massima di esercizio: 100°C
Temperatura minima di esercizio: -10°C

Fluido:
Acqua e liquidi neutri, miscele di acqua-glicole (0-57%).

Materiali:
Corpo valvola: Ghisa sferoidale EN-GJS-400-15
Membrane e guarnizioni: NBR, EPDM

Trattamento superficiale:
Verniciatura per elettroforesi

Marcatura:
IMI TA, DN, PN, Kvs, materiale e freccia direzione flusso.

Collegamento:
DN 15-50: Filetto maschio a norma ISO 228.
DN 65-125: Flange a norma EN-1092-2, tipo 21.

2.3.9. Filters

2.3.9.1. Filters with Threaded Connections

- Y-type bronze, PN 16, with stainless steel mesh filter element;
- Socket connections, gas threaded;

2.3.9.2. Filters with Flanged Connections

- Y-type cast iron, PN 16, with 18/8 stainless steel mesh filter element;
- Cover gaskets in klingerite or equivalent material;
- Drain plug on the cover;
- Flange connections;
- Complete with counter flanges, bolts, and gaskets;

2.3.10. Safety Valves

Safety valves must be provided wherever the current INAIL regulations and good installation practices prescribe or recommend their use. The company is required to submit the relevant calculations for approval and subsequently the INAIL homologation certificates.

2.3.11. Miscellaneous and Accessories

2.3.11.1. Anti-Vibration Joints PN 10

- Thrust-eliminated type;
- Cylindrical rubber body in vulcanized rubber contained between steel flanges;
- Complete with counter flanges and bolts with spring washers;

2.3.11.2. Rubber Compensators PN 16

- Spherical wave type, in neoprene reinforced with nylon;
- Steel flanges according to UNI standards, threaded connections allowed up to 1 1/4";
- Complete with counter flanges and bolts and travel limiters with shock absorbers;

2.3.11.3. Filling Valves

The filling groups for systems consist of: pressure reducer with integrated filter and non-return valve, upstream and downstream shut-off, bypass with shut-off, pressure gauge as specified upstream and downstream.

When not already provided upstream, a hydraulic disconnector with a reduced pressure zone must also be installed.

The pressure reducers must have the following characteristics:

- Self-operated pressure reducing valves;
- Cast iron or brass body;
- Internal parts in brass;
- Perfectly sealing shutter;
- Neoprene diaphragm;

2.3.11.4. Air separators

- For diameters up to 1 1/2": brass air separators, stainless steel separator element, rubber sealing gaskets, automatic float air eliminator; threaded connections (Ref. Caleffi Discal or Flamco Vent Junior).
- For diameters from DN 50 and above: carbon steel air separators painted with epoxy powders, stainless steel separator element, rubber sealing gaskets, automatic float air eliminator; manual air drain valve, bottom drain with shut-off valve, PN 16 flanged connections, complete with counter flanges, bolts, and gaskets.

2.3.11.5. Automatic Air Eliminators

- For distribution networks, risers, main collectors, distribution in technical centers: barrel-type automatic air eliminators, brass body and cover, stainless steel float, O-ring sealing gaskets, stainless steel filter, stainless steel shutter with rubberized sealing seats, complete with inlet shut-off valve and discharge directed to collection pits. Ref. Caleffi Maxcal.

- Alternatively, in cases of space constraints, automatic float air separators with shut-off and exclusion valve. Ref. Flamco Flexvent.
- For secondary distribution collectors (copper or plastic distribution networks), and for systems with thermal capacity not exceeding 70 kW: automatic float air vent valves, chrome-plated brass body and cover, plastic float, O-ring sealing gaskets, complete with shut-off valve and anti-suction valve.

2.3.11.6. Water Hammer Arrestors

- Columns with diameter up to 2": elastic expansion damper reference Cazzaniga type Antibelier;
- Columns with diameter greater than 2": resettable air cushion system, with 80 mm steel tube barrel with domed ends, galvanized, approximately 500 mm long, 1/2" ball valves on air reset and drain, and shut-off ball valve on the column connection.

2.3.11.7. Automatic Flow Stabilizers

- Automatic flow regulators to a preset value, within a working pressure range;
- Brass body up to DN 80, cast iron for larger diameters;
- Stainless steel spring;
- Self-regulating nickel-plated brass piston;
- Complete with piezometric connections for measuring differential pressure between inlet and outlet;
- Threaded connections up to Ø 1 1/2", wafer type for mounting between flanges for larger diameters;
- Complete with threaded sockets and three-piece unions up to Ø 1 1/2", or collar flanges, bolted tie rods, and gaskets for larger diameters.

2.3.11.8. Cast Iron Plug Valves with Flanged Cap PN 10, Two/Three-Way

- Bronze plug;
- Cast iron body, cap, and gland;
- Flange connections;
- Complete with counter flanges, bolts, and gaskets;

2.3.11.9. Pressure reducing valves

- Compensated seat pressure reducer according to EN 1567. Threaded connections 1 1/2” M (from 1 1/2” and 2”) with union.
- Bronze body;
- Stainless steel seat and filter;
- NBR diaphragm and sealing gasket;
- Maximum operating temperature 80°C;
- Maximum upstream pressure 25 bar;
- Downstream pressure adjustment range from 0.5 to 6 bar;
- Sliding surfaces hot-coated with PTFE;
- Cartridge with diaphragm, filter, seat, and shutter, removable for maintenance operations.

2.3.11.10. Magnetic dirt separators

The dirt separator must be installed according to the diagram.
It protects critical system components – boilers, pumps, valves, meters, and chillers – from malfunctions and failures due to the presence of sludge and impurities. There is no risk of clogging and blockage: the collected impurities can be easily and quickly removed thanks to the drain valve. It reduces the necessary maintenance on components throughout the system's lifespan, resulting in cost savings. Accessory insulating shell with magnets Capable of further enhancing the efficiency of separating sludge and magnetite (black-colored iron oxide) consisting of very fine magnetic particles. Very easy to install and use.
Magnetic sheath. Magnet T-connector with magnetic rod and immersion sleeve. To increase magnetite retention.

Caratteristiche tecniche

Applicazioni:
Sistemi di riscaldamento, raffrescamento e solari.

Fluido:
Sistema atossico e non aggressivo.
Additivo antigelo fino al 50%.

Pressione:
Pressione massima ammissibile,
PS: 10 bar
Pressione massima ammissibile,
PSmin: 0 bar

Temperatura:
Mass. temperatura ammissibile,
TS: 110°C
Min. temperatura ammissibile,
TSmin: -10 °C

Materiali:
Acciaio. Colore berillio.

Collegamento:
Flange a norma EN-1092-1.

Norme di riferimento:
Costruito a norma PED 2014/68/EU.

Trasporto e stoccaggio:
In un luogo asciutto e con temperatura > 0°C.

Ensure sufficient space for maintenance.

2.3.12. Schedule of accepted general service valves and strainers

2.3.12.1. Valves for isolation

Service	Size mm	Type	Body	Connections	Min PN Rating	Additional Requirements
Cold watermains/ Cold water services/ Domestic Hot Water Services	15-54	Lever Handle Ball Valve	DZR	Compression	16	
	15-50	Lever Handle Ball Valve	DZR	Screwed	16	

2.3.12.2. Double regulation

Service	Size mm	Type	Body	Connections	Min PN Rating	Additional Requirements
Domestic Hot Water Services	15-50	Oblique Globe	Bronze Bronze DZR Bronze	Screwed or Compression	20	
	15-50	Oblique Globe	Bronze Bronze DZT	Screwed or Compression	20	Low flow 0.01-0.04 l/s Low flow 0.01-0.04 l/s Low flow 0.01-0.04 l/s

2.3.12.3. Stop valves

Service	Size mm	Type	Body	Connections	Min PN Rating	Additional Requirements
Cold water mains	15-22		Gunmetal	Compression	16	
	28-54		Gunmetal	Compression	10	

2.3.12.4. Service valves

Service valves

Service	Size mm	Type	Body	Connections	Min PN Rating	Additional Requirements
Cold water mains	15-22	Lever Handle Ball Valve	DZ Brass	Compression	10	
	15-22	Lever Handle Ball Valve	DZ Brass	Compression	10	

Service valves with flow limiting cartridge

Service	Size mm	Type	Body	Connections	Min PN Rating	Additional Requirements
Cold water mains/ Cold Water Services/ Domestic Hot Water Service	15-22	Lever Handle Ball Valve	DZ Brass	Compression	10	

2.3.12.5. Double check valve

Service	Size mm	Type	Body	Connections	Min PN Rating	Additional Requirements
Cold water mains/ Cold Water Services/ Domestic Hot Water Service	15-28	Double Check Valve	DZR	Compression	16	
	15-22	Double Check Valve	DZR	Compression	16	
	15-50	Double Check Valve	DZR	Compression Or Screw	16	

2.3.12.6. Drain taps

Service	Size mm	Type	Body	Connections	Min PN Rating	Additional Requirements
Cold water mains/ Cold water services/ Domestic Hot Water Services	15-50	Drain Valves	Bronze Gunmetal	Screwed	10	Hose union connector Hose union connector Hose union connector
	15-15	Ball Valve	Bronze	Screwed	10	Hose union connector Hose union connector Hose union connector Hose union connector
	15-25	Drain Trap	Bronze/DZR Bronze DZR	Screwed	10	Hose union connector Hose union connector Hose union connector

2.3.12.7. Check valves (single non return)

Service	Size mm	Type	Body	Connections	Min PN Rating	Additional Requirements
Cold water mains/ Cold water services/ Domestic Hot Water Services	15-50	Swing Check	Bronze Bronze Gunmetal Bronze	Screwed	106	
	65-150	Swing Check	Cast Iron	Flanged	16	

2.3.12.8. Pressure reducing valves

Service	Size mm	Type	Body	Connections	Min PN Rating	Additional Requirements
				Screwed		

2.3.12.9. Thermostatic regulating valve

Service	Size mm	Type	Body	Connections	Min PN Rating	Additional Requirements
Domestic Hot Water	15-22	Thermostatic	DZR	Screwed	16	

2.3.12.10. Thermostatic blending valves

Service	Size mm	Type	Body	Connections	Min PN Rating	Additional Requirements
Domestic Hot Water Service	15-22	Thermostatic	Gun Metal DZR	Screwed	16	For Office and Dwellings TMV-2 For Hospitals, Clinics and Nursing Homes TMV-3
	15-22		DZR	Compression	16	

2.3.12.11. Filters

Service	Size mm	Type	Body	Connections	Min PN Rating	Additional Requirements
Cold water mains/ Cold water Service	15-50	Y-Pattern	Bronze	Screwed Or compression	16	Strainer

2.3.13. Tables of valves, cocks and strainers

Valves for isolation

Service	Size mm	Type	Body	Connections	Min. PN Rating	Additional Requirements
Fuel Oil	15 – 50	Ball		Screwed		
Compressed Air	15 – 50	Ball	DZR	Screwed		
	65 – 150	Butterfly	Ductile Iron	Between flanges	16	Fully lugged, lever operated
	200 +	Butterfly	Ductile Iron	Between flanges	16	Fully lugged, gear operated

Non return valves

Service	Size mm	Type	Body	Connections	Min. PN Rating	Additional Requirements
Fuel Oil	15 – 50	Swing Check	Gunmetal	Screwed	16	
			Bronze			
	65 – 300	Wafer	Stainless Steel	Between flanges	16	
Compressed Air	15 – 50	Lift Check	Bronze	Screwed	16	
	65 - 150	Swing Check	Cast Iron	Flanged	16	

Filters

Service	Size mm	Type	Body	Connections	Min. PN Rating	Additional Requirements
Condensate	15 – 50	Y Pattern	Bronze	Screwed	25 25	
Fuel Oil	15 – 50	Y Pattern	SG Iron	Screwed	25	
Compressed Air	65 – 300	Y Pattern		Flanged	25	
	15 – 50		Cast Steel	Screwed		
	15 – 50		SG Iron	Screwed		

Drain valves

Service	Size mm	Type	Body	Connections	Min. PN Rating	Additional Requirements
HTHW (up to 180ºC)	15 – 50	Gland Cock		Screwed / Welded		Capped end and remote HUC
	15 - 25	Drain Tap				
Steam (up to 10 bar g)	15 - 50	Gland Cock		Screwed / Welded		Capped end and remote HUC
		Ball Valve				
	15 - 25	Drain Tap				
Condensate	15 - 50	Gland Cock		Screwed		Capped end and remote HUC
		Ball Valve				
		Drain Tap				
Fuel Oil	15 - 50			Screwed		
Compressed Air	15 - 50			Screwed		

Accessories

Service	Size mm	Type	Body	Connections	Min. PN Rating	Additional Requirements
Pressure Gauge Cocks						
Steam Condensate Natural Gas Compressed Air	6 – 15	Needle	Bronze	Screwed	32	
Ball Float Valves for Non-domestic Water Services						
LTHW Chilled Water Condensate Water Condensate	15 – 25					
	25 - 50					
	65 - 150					

Service	Size mm	Type	Body	Connections	Min. PN Rating	Additional Requirements
Safety Relief Valves						
Compressed Air	15 – 50		Gunmetal	Screwed		Also Soft Seal
			Bronze	Screwed		

2.3.14. Test point locations, pressure gauges and thermometers

2.3.14.1. Test point

Test points are defined in this section of the Specification as self-sealing fittings installed into pipelines to enable the pressure and / or temperature to be checked whilst the system is active.

Conventional test points shall not be used on high temperature or high pressure systems or steam systems.

On insulated pipework the test point shall be extended through the insulation layer and vapour barrier.

Test point location

In addition to the locations indicated on the drawings, test points shall be provided in the following locations:

1. At all heat exchangers (except on units where the output exceeds 200 kW where gauges shall be provided).
2. At all BMS and other pipeline sensor positions.
3. At all control valves on each port.
4. At all water system terminal units.
5. At boiler plant flow and return headers.
6. At all strainers (except 100 mm and over where gauges shall be provided).
7. At all permanently installed pressure and temperature gauges.

2.3.14.2. Boiler gauges

Boilers shall have a minimum of a 100 mm dial flow temperature gauge, return temperature gauge and pressure gauge.

2.3.14.3. Heat Exchanger Gauges

Temperature gauges shall be provided on all heat exchangers exceeding 200 kW output.
Non-storage water / water heat exchangers shall have flow and return temperature gauges on both primary and secondary side.
Steam heat exchangers shall be as for water with an additional pressure gauge on primary circuit.

2.3.14.4. Pump Gauges

All circulation pumps, except small circulators up to 32 mm, shall have separate pressure gauges on both suction and delivery connections and they shall be remote mounted. They shall be mounted on hardwood boards of 20 mm thick with bevelled edges and polished finish and of sufficient size to provide a neat workmanlike appearance. Alternatively, a primed, undercoated and glossed steel gauge board may be used.

The gauge boards shall be supported by a galvanised steel framework rigidly fixed to the floor, adjacent to the pumps.

All capillary tubes to remote gauges shall be supported upon their entire length including the final connection to the equipment, on PVC coated electrical cable tray supplied and installed by the contractor.

Gauges shall be labelled "SUCTION" and "DELIVERY" together with a label identifying pump function.

2.3.14.5. Pressure gauges

Pressure gauges shall be Bourdon tube type with a red movable pointer to indicate working pressure and have a scale range accuracy of 1%.

Gauge ranges shall be selected as near as is possible to be approximately twice the normal working pressure so that the pointer is at the centre and generally in accordance with the following table. Excessive scale ranges will not be accepted. Minimum gauge size 100 mm dial.

Pressures	**(bar)**	1.5	2.5	3.0	4.5	10
Gauge Range	**(bar)**	0-3	0-5	0-6	0-10	0-20
Figure Intervals	**(bar)**	0.5	1	1	1	2
Intermediate	**(mbar)**	100	100	100	100	500

Where mounted on gauge boards gauges with suitable back plates shall be provided.
All pressure gauges shall be provided with gauge siphons and isolating valves, as specified.

2.3.14.6. Differential Pressure Gauges

Shall be of the diaphragm type with red point and normally reading in mbar. Scale range shall be approximately twice the required differential. Minimum gauge size 100 mm dial.

Care shall be taken to ensure that the gauge is not subjected to pressures or differentials greater than the gauge capacity.

Back plate gauges shall be provided where mounted on a board.

When installing DP gauges, isolating valves shall be provided between gauge and pipeline together with an interconnecting (balancing) pipe and valve, as recommended by the manufacturer.

2.3.14.7. Thermometers

Shall be dial expansion type with either back or bottom entry.
Scales shall be in °C and calibrated 0°C to 120°C with divisions at 1°C intervals and shall be numbered at 10°C increments with bold figures or, as far as practical, twice the normal operating temperature of the system.
Minimum gauge size shall comprise a 100 mm dial.

All thermometers shall be removable and installed in brass pockets filled with conductive gel.
Pockets shall be installed in positions and have sufficient depth to accurately measure the desired fluid.

The gauge shall be complete with matt black mild steel case with chromium-plated bezel and shall be linked by means of a capillary tube to a sensor bulb located within the immersion pocket.

2.3.14.8. Gauges Types

Application	Type	Construction	Appearance
Pressure Gauge	Bourdon tube	Steel case	Black enamelled
		Steel bezel	Chromium-plated
Differential Pressure Gauge	Diaphragm	Steel case	Black enamelled
		Steel bezel	Chromium-plated
Thermometer	Bourdon tube expansion	Steel case	Black enamelled

2.3.15. Closed expansion vessel with membrane

Vaso di espansione in lamiera di acciaio saldata di spessore idoneo alla pressione di bollo, completo di punzonatura
Expansion vessel made of welded steel sheet with a thickness suitable for the pressure rating, complete with I.S.P.E.S.L. stamping, and an internal rubber membrane with high resistance and elasticity, for the separation between liquid and pre-charged nitrogen.

Wall-mounted execution up to a capacity of 25 liters, floor-mounted with a base for larger sizes.

Pressure rating of 500 KPa for crimped tanks and 600 KPa for welded tanks. Max operating temperature 95°C. Complete with threaded gas connection for circuit connection and all other charges to deliver the finished work.

The expansion vessel will be installed on the expansion line, directly connected to the circuit without any interposed shut-off devices, and at a point characterized by low operating pressure.

The vessel will be insulated and covered with the same material used in the line to which it is connected. A pressure gauge for reading the operating pressure must be installed on the pipe section at the connection of the expansion line.

It is the contractor's responsibility to size the expansion vessels for the various circuits based on the actual water content.

2.3.15.1. Construction features

Main characteristics of the expansion vessels:
- Closed type, pressurized with nitrogen pre-charge;
- Steel sheet construction;
- Rubber membrane;
- Construction, dimensions, and testing according to INAIL standards.

2.3.15.2. Accessories

The vessels must be complete with:
- Pressure gauge as specified, complete with gauge holder with three-way valve, test flange, and spiral;
- Supports and fixing brackets;
- Tags indicating the vessel and circuit code, made of galvanized steel or plastic material with a transparent plexiglass protective screen; the equipment codes must be consistent with the as-built documentation identifications.

2.3.15.3. Installation methods

- Vessel equipped with its own supports (pipe hooks are not allowed);
- Filling group complete with shut-off valves and bypass, filter, pressure reducer with upstream and downstream gauges, check valve.

2.3.15.4. Testing

- Measurement of pressure in the vessel, in both hot and cold circuits;
- Mechanical testing at the factory in accordance with INAIL standards and presentation of the relevant certification.

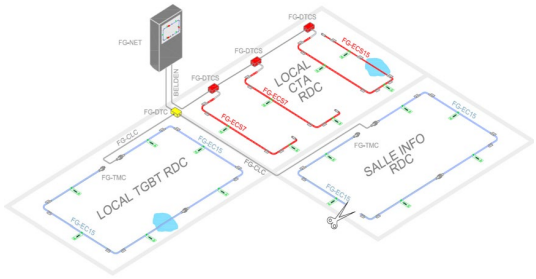
2.4. Leak detection cable, sensors and alarm unit

Various sense cables are connected to others to form one or more detection circuits.

Jumper cables and/or diversion boxes complete the circuit between the sense cables. The detection and the location of a leak or a cable break are carried out on each sense cable by an electronic circuit integrated into the end of the cable.

The Digital Panel questions each sense cable individually. Each sense cable transmits information of the problem back to it. The Digital Panel recognises the cables name and shows the characteristics of the problem: type of defect, location, date and time. There can be as many defects detected as cables installed. The location of each leak or cable break will be given to within one metre.

Example of the architecture:



If the three defects of the diagram above were present at the same time, the information given by the Control Unit would be as follows:

Leak in Local TGBT Gd Floor at 16m, 23/03/2017 at 18H31
Leak in Local CTA Cable 3 at 13m, 23/03/2017 at 23H27
Cable Break in Data Hall Gd Floor at 18m, 24/03/2017 at 00H03

More generally, when a conducting liquid is in contact with a point on the sense cable placed in one of the protected rooms:

- Activation of an audible and luminous alarm on Control Panel.
- The Touch Screen on the panel shows the fault.
- The unit will display the name of the sense cable and the location in metres of the break point or leak on the screen.
- It will also show the date and the time of the defect
- The 8 hard wired contacts can be activated (possible configuration in NO or NC).
- Information is also transmitted in mode JBUS on exit RS232/RS485

Cable break of one of the circuits of sense cables or connection:

- Activation of an alarm both audible and visual on the FG-NET showing the details. Name of the cable.
- Date and the time of the defect.
- The dry contacts of defect are activated.
- Information is transmitted in mode JBUS on exit RS232.

With the disappearance of a defect (leak or cable break), the Control Unit acknowledges this and the information will disappear into the history: The screen goes to standby. The display returns to normal at the end of two minutes and indicates that all of the zones remain under monitoring and the contacts return to their original position.

Technical Description

Digital panel

The liquid leak detection unit suggested is a stand-alone Control Panel, wall-mounted or rack-mounted in a 19 "rack.
This Unit can independently receive and control information for up to 120 sense cables of 3, 7 and 15 meters.

The Touch Screen displays accurate and detailed information regarding leaks, picked up via the sense cables.

History: the Control Panel stores the history of the last 5000 events.
Format: Control Panel is available in wall-mounted or rack-mounted versions 19". Power Supplies and Battery:
The Control Panel is rated for mains voltage of 230V single phase 50Hz with an internal battery for memory back up. The panel does not have its own sealed lead-acid battery back-up, and would therefore recommend installing the system to use the mains backup facility.

Control Panel Sizes/Capacity:

The Control Panel is able to manage all of its detection devices and more than 10% of spare capacity will be built in for further expansion when quoting for the number of panels and detection devices installed.

Audible Alarm: The audible alarm is provided in the Control Panel as standard and this alarm is activated once the sense cable is in contact with a liquid, or a break in the connection to the cable itself

Visual Alarm/Display:

The Control Palen has a 7" Touch Screen which is activated as soon as it is touched or in the event of an alarm. The system is fully programmable with the ability to name every individual sense cable, because they are addressable. The system will automatically scroll through the leaks picked up on the system and relay this information via the TCP/IP, to the security team and by Modbus back to the BMS.

The fault depicted will have a red marker until the faults have been cleared. The documentation attached shows a typical example of the unit displaying its alarms.

Communications and Alarm Outputs:

The Control Panel has a TCP/IP connection for independent communication through the Intranet as well as RS 485 / 232 and 425 to provide full communication with the BMS system.
The unit has 64 volt-free contacts per panel with the opportunity to extend if necessary.
Vendor will provide a comprehensive I/O schedule for all of the leak detection cabling or points to the company dealing with this.

Operator controls:

The Control Panel allows limited access to the panel and full access is only available once a password is entered, which is passed onto the End User.

History Events/ System Profile Data:

The Control Panel alarm system will log up to 5000 events. A printer can be installed on the system to print off all relevant information as it happens, but the information is relayed via the BMS immediately and logged.
Access to the history is simple through the panel.

Remote Alarm Indication:
The Control Panel has the ability to operate remote alarms, buzzers, lights and sirens through the dry contacts without the need for additional power

Cable

The sense cable consists of 4-spiral wires around a blue central core in fireproofed and LSZH: PELD.
The central core is made of four wires, a pair for the power supply, the other for the transmission of the signal.

The electronic circuit is controlled by a micro-processor integrated at the end of each cable. This circuit provides a double function: The detection and location of the fault on the sense cable, the communication of information to the Digital Unit

Plugs finish the cables – with a female and male connector making, it possible to connect them to the others in linear fashion.
Three families of sense cables allow detecting of all types of liquid: Water/acids/hydrocarbon and solvents.

The sense cables proposed are in lengths of 15, 7 and 3 metres.
These cables and their accessories are equipped with modular and pre-terminated plugs allowing an immediate and easy connection.

Sense cable are resistant, fireproofed and consequently a non-propagator of fire;
Their construction is studied to avoid any alarm other than that caused by the presence of a conducting liquid, like water.

The water sensing cables will be placed in the false floors, of the various technical buildings to be protected; the cables will be fixed to the ground and bonded by a glue adhesive one metre apart.
Fixing must be made possible on a flat surface to avoid being accidentally moved over time.

Sense cables are blue fluorescent colour and will be marked by descriptive adapted tags.

Water Leak Detection Cable Specifications:
- Maximum operating temperature: 65°C
- Maximum length per unit of the digital sensitive cable: up to 120 sections connected to 3 circuits
- Connection type: Clipper
- Weight: 25g per meter (without connector)
- Diameter of the sensitive cable: 7.5mm with coating (without connector)
- Cable certifications: CE / FM Approved

Control Unit Specifications:
- Maximum operating temperature: 55°C
- Weight and dimensions:
    - For wall mounting – 2.3 kg / 228x303x67 mm
    - For rack mounting – 3 kg / 483x177x74 mm
- Serial connection: Modbus / Jbus RS232/422/485
- Power supply voltage: 100-240 Vac
- Protection class: IP40 – Indoor use only
- Certifications: CE / UL / FM Approved / Ex

Reference model: TTK

2.5. Glycol

2.5.1. Glycol for secondary circuit (CDU to rack)

Glycol type for secondary circuit from CDU to rack: Inhibited monoethylene glycol, *Dowfrost LC25*.
Percentage of glycol for secondary circuit to CDU to be considered as 30%.

As requested by the Client, it is necessary to provide 3 spare pallets (1.2x1.2 m) next to the CDUs (dirty coolant, clean coolant, spare).

Product Use and Formulating

Maximum Operating Temperature in °F(°C)	195°F (90°C)
Recommended Use	Cooling
Temperature Use Range in °F (°C)	0°F*(-20°C) to 195°F (90°C)

Typical Properties

Fluid Base	Propylene Glycol
Freezing Point in °F(°C)	DOWFROST™ LC 25 - 14°F*(-10°C) / DOWFROST™ LC 55 - -40°F*(-40°C)
Product Type	Glycol-Water HTF
Type	Inhibited Glycol

2.5.2. Glycol for chillers freecooling circuit

Glycol type for secondary circuit from CDU to rack: Inhibited mono-ethylene glycol
Clear colourless liquid. Nitrite, amine and phosphate free.

CARATTERISTICHE CHARACTERISTICS	UNITA' DI MISURA UNIT MEASURE	METODO DI ANALISI TEST METHOD	LIMITI STANDARD STANDARD LIMITS
Densita' a 15°C / Density at 15°C	g/ml	ASTM D 1122	1,03 - 1,05
pH (Sol. 50% in acqua) / pH value (50% Sol. In water)	-	ASTM D 1287	7,0 - 11,0
Alcalinità di riserva / Alkalinity reserve	-	ASTEM D 1121	10 min
Ceneri / Ash	%p	ASTM D 1119	1 max
Punto di congelamento / Freezing point	° C	ASTM D 1177	-12
Punto di ebollizione (Sol. 50% in acqua) Boiling point (50% Sol. In water)	° C	ASTM D 1120	104,4 min
Solubilità in acqua / Solubility in water	-	Visivo	Completa
Resistenza alle acque dure / Resistance to hard water	-	NC 956-14	Limpido

Test di corrosione (perdita in peso mg/provino) Corrosion Test (weight loss mg/sample) ASTM D 1384	Specifica/Specific Chimigel E	Limiti/Limits ASTM D 3306
Rame / Copper	0,8	10 max*
Lega da saldatura / Solder alloy	2,2	30 max*
Ottone / Brass	0,8	10 max*
Acciaio / Steel	0,1	10 max*
Ferro / Iron	0,2	10 max*
Alluminio / Aluminium	0,6	30 max*

Test di corrosione (perdita in peso mg/provino) Corrosion Test (weight loss mg/sample) ASTM D 2570	Specifica/Specific Chimigel E	Limiti/Limits ASTM D 3306
Rame / Copper	1,1	20 max*
Lega da saldatura / Solder alloy	4,2	60 max*
Ottone / Brass	1	20 max*
Acciaio / Steel	0,3	20 max*
Ferro / Iron	1,6	20 max*
Alluminio / Aluminium	2,2	60 max*

*Valori riferiti al glicole monoetilenico con grado di purezza maggiore del 95%p
*Values referring to monoethylene glycol with a degree of purity greater than 95%p

The percentage of glycol, to insert in the circuit, has to be defined by Client based on the external design temperature. Do not exceed maximum percentage of glycol which is 35%.

On chiller free-cooling water needs to be in line with following parameter:

pH	---	7,5 - 9,0
Alkalinity (HCO_3^-)	ppm	70 - 200
SO_4^{2-}	ppm	< 100
HCO_3^- / SO_4^{2-}	---	> 1,5
(Ca+Mg)/(HCO_3^-)	---	> 0,5
Cl^-	ppm	< 100
PO_4^{3-}	ppm	< 2,0
NH_3	ppm	< 0,5
Nitrate(NO_3^-)	ppm	< 100
Free Chlorine (Cl_2)	ppm	< 1
Iron Fe^{3+}	ppm	< 1
Copper Cu	ppm	< 1
CO_2	ppm	< 10
H_2S	ppb	< 50
Oxygen content	ppm	< 0,1
Total Suspended solids	mg/l	< 1500
Electric conducibility	µS/cm	10 - 500
Total hardness	dH	4,0 - 8,5

Mixed Glycol stems have to be placed near (1 -2 meters) interested chiller.
Mixed Glycol has to be available at chiller startup of each single chiller.

Consider to provide a small spare quantity (100 liters in total) of glycol + water to cover possible small leaks during filling activity.

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Potable and non potable water storage tanks
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

Document: A10 ES E CM 01-

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1. INTRODUCTION

This specification details the requirements for potable and non potable water storage tanks

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications.

2. TECHNICAL FEATURES

Reference will be made to the Project documentation for details regarding the requirements of the tanks, capacity, dimensional sizes, construction, and connections to services.
The following requirements apply to all tanks to be supplied and constructed for the containment of drinking water.
All storage tanks must comply with Legislative Decree No. 31 of 2001, the materials used must be WRC approved, and the tanks constructed in such a way as not to promote bacterial growth.

The tanks will be equipped with internal partition plates to create two independent compartments for maintenance. The internal partition plates must be adequately reinforced to allow the draining of one compartment while the other compartment remains operational.
The separate compartments of the tank must be provided with a valved interconnection manifold from which the various distribution services depart.

Each compartment must be equipped with a connection for draining the tank's contents, which must be fitted with a lockable valve and connected to a convenient discharge point on a drainage system to discharge to the open air at least 150 mm above the discharge point.

Each compartment must be equipped with an overflow of adequate size to carry away all the water discharged into the tank in the event that the inlet control device, i.e., the float valve, becomes defective, without submerging the inlet control device. Additionally, a warning pipe with a diameter of not less than 28 mm must be provided at least 50 mm below the lowest point of the overflow in the event that the tanks exceed 1,000 liters.
For tanks larger than 10,000 liters, a device may be installed to provide an audible or visual alarm in place of a warning pipe as detailed in the project documentation.

The overflow and warning pipes must be independently connected to a discharge point on a drainage system to discharge to the open air at least 150 mm above the discharge point. Pipes discharging to a common point must be labeled to identify the source of the discharge.
All overflow and associated pipes must be labeled along their entire length and fitted with screens to prevent the entry of insects and pests. The device must be fitted with a corrosion-resistant mesh with maximum perforations of 0.65 mm in diameter and still maintain the cross-sectional area of the overflow pipe.

Each compartment must be equipped with an air intake fan fitted with a corrosion-resistant mesh screen with maximum perforations of 0.65 mm in diameter to prevent the entry of insects and pests.
Each compartment must be equipped with hinged and lockable access covers or securely bolted, appropriately sized for the maintenance of the float valve.
All tanks must be equipped with internal ladders constructed of GRP or 316 stainless steel where man entry is required for tanks 1.2 meters deep or more.
The tank covers must be heavy-duty flat covers bolted, constructed of materials that will not contaminate the water that may condense on the underside.
External ladders in mild steel or galvanized aluminum must be provided outside the tank, constructed in accordance with ISO 14122 for easy access to the positions of the float-operated valves.
The entire tank must be insulated against heat and frost in accordance with this Specification.

Cold water storage tanks must be externally flanged. Tanks with internally flanged bases must not be installed.
Internally flanged sides should be avoided.

2.1. Pre-autoclave tank / break tank

The pre-autoclave or break tank is a horizontal or vertical pressure vessel, cylindrical type, that have the function of potable water reservoir connected directly to the public water supply. It will have to be installed between the water mains and the pressurization unit to maintain constant pressure in the water mains at times of maximum demand and ensure water hygienicity.
It will have to be suitable for the containment of water intended for human consumption and I.S.P.E.S.L. certified.

Construction features:
- high quality and thick steel plate construction,
- internal and external hot-bath galvanizing carried out upon completion of processing,
- anti-condensation insulation coating with glass wool cupels, 30 mm thick, sealing of joints with special adhesive, wrapping with corrugated cardboard, protective finish with 6/10 mm thick aluminum sheet metal,
- floor support brackets.
- Whenever required the tank shall be supplied in AISI 316 stainless steel.

ACCESSORIES: The pre-autoclave tank shall be supplied complete with the following accessories:
- minimum pressure switch set at 1 bar,
- maximum pressure switch air solenoid valve disconnect,
- pressure gauge approved by I.S.P.E.S.L. ,
- safety valve approved by I.S.P.E.S.L. ,
- three-way valve,
- drain valve,
- level indicators,
- flanged connections,
- inspection hatch,
- level regulator.

AIR COMPRESSOR
- The tank will be supplied complete with an electric air compressor to restore and maintain the air cushion.
- Whenever there are two pre-autoclaves, or one pre-autoclave and one autoclave, the compressor will serve the two tanks.
- In order to ensure oil-free compressed air, the compressor will be of the oil-free type, that is, without lubricating oil inside the pumping unit. The moving parts (piston and shaft) will be made of materials with a low coefficient of friction and high resistance to wear, so they will not require lubrication during use.
- The compressor will be of the belt-driven twin-cylinder type with a compressed air storage tank made of thick steel plate. The tank will be provided with certification whenever required by regulations.
- The compressor will be supplied complete with an electrical control panel, pressure switch, hand-meter, safety valve, bleed valve, and check valve

2.2. Hot pressed fiberglass reinforced polyester (GRP) potable water storage tanks

The vessel shall be constructed to the relevant parts of UNI EN 13445 "Unfired pressure vessels" and UNI EN 13445 "Unfired Pressure Vessels" and shall comply in all respects with the 2014/68/EU Pressure Equipment Directive (PED).
All tanks, tank manufacturers shall be certified under the WRAS approval scheme.
Water storage tank erection and testing shall be supervised by the manufacturer.

Provide hot-pressed fiberglass-reinforced polyester (GRP) material covered water storage tank assemblies as indicated on the drawings. Each tank shall be constructed with external reinforcement and fitted with trim and accessories as required to receive, store and dispense water as indicated.
GRP tanks: Tanks shall be two compartments, rectangular, conforming to EN 13121, constructed from bolted and gasketed sectional panels. All flanges shall be external, and all bolts, nuts and washers shall be manufactured from type 316L stainless steel. Provide type 316L stainless steel reinforcing "C" channels, angles, stay plates and stay bolts reinforcing as required.

Panels: Panels shall be moulded and pressed, constructed from resin bonded fiberglass-reinforced polyester with continuous woven filaments of sufficient thickness to meet the hydrostatic requirements of the dimensioned tank. Panels shall be 1.0m wide and generally 1.0m high although 1.5m high panels may be used as required for efficient water storage. Drain sump panels shall be provided to ensure the tank can be completely drained. Panels shall be opaque to prevent micro-biological growth within the tank.

Inlet/ outlet nozzles: All nozzle fittings shall be constructed of uPVC/ ABS double flanged either side of water tank panel connections sized as indicated on the drawings. Connections 65mm and smaller shall be screwed, 80mm and larger flanged. An anti-vortex breaker shall be provided for all outlet connections.

Accessories:
- Screened uPVC/ ABS vent for tank top for each compartment.
- Provide internal and external type 316L stainless steel factory fabricated ladder and safety cage assembly.
- Stainless-steel identification plate stating capacity of storage and use shall be provided, with letters at least 50 mm high.
- Lockable hinged access covers, minimum 450mm diameter, complete with type 316L stainless steel brackets, hinges and fixings for each compartment.
- Contents gauge for each compartment as indicated above.

Installation: The installation of sectional water tanks shall be undertaken by the tank manufacturer and leak tested for a period of 48-hours.

Builders work: Sectional tanks shall be mounted upon upstand concrete piers of sufficient height to allow man-access beneath the tank to attend to minor instances of leakage

ACCESSORIES
The tanks shall be provided with all accessories, for each compartment, necessary for the operation and maintenance of the system including but not limited to:
- Lockable manhole access hatches
- Internal ladder
- Overflow
- Warning pipe

- Screened vent
- Visual magnetic water level gauges
- IP rated lighting local to access door
- Primary fill line and failsafe ball valve
- Secondary manual fill line
- Suction nozzle and anti-vortex plate
- Test and drain points

Visual Magnetic Water Level Indicators

- Visual magnetic water level indicators shall be provided for each water storage tank compartment; they shall have integral switches to provide remote indication to the BMS of water level conditions and initiated operation of transfer pumps.
- Magnetic water level indicators should be able to work at temperatures up to 399°C and pressures up to 48 bars.
- Should have a rugged welded construction for a long service life.
- Mounting and Float material shall be Stainless Steel 316L.
- Mounting configuration shall be as per below types, depending upon the water tank installation.

2.3. Steel storage tanks

The tanks must be constructed from UNI EN 10029 Grade 43A quality steel, hot-pressed in a single piece with flanges on all four sides on a 1.0 x 1.0 m plate or a 1.22 x 1.22 m plate according to UNI EN 12285.
The internal strips and stays must be made of steel in accordance with UNI EN 10029 "Hot-rolled steel sheets of thickness equal to or greater than 3 mm. Tolerances on dimensions and shape," Grade 43A, designed to ensure the maintenance of the required strength and rigidity for the tank dimensions.
The plates will be supplied by the manufacturer with a coat of non-toxic black bituminous primer. The tank must be assembled by the manufacturer, and after assembly, two additional coats of non-toxic bituminous paint will be applied before testing. The external decorative painting must be carried out by the contractor according to the engineer's requirements.
The panels must be assembled and bolted together with 12 mm stainless steel nuts and bolts conforming to type 316/A4 according to UNI EN ISO 3506-1 and must be provided with flat washers at the bolt head and nut.
The manufacturer's sealing strip must be laid between each joint and must be non-toxic and prohibitive for the support of bacteriological or fungal growth.

2.4. Non potable water storage tank in LLDPE

The tanks for rainwater recovery can be for underground installation in linear low-density polyethylene (LLDPE) complete with:

- Dual pump
- Multi-stage filter
- Control panel for three-phase dual pump with pressure switches, 24-liter expansion vessel, valves, probe, and rain control.

Function: The stations for automatic irrigation with modular tanks are designed for the storage of large volumes of rainwater or treated water and subsequent reuse. Thanks to the submersible electric pump, the stored water can be used to

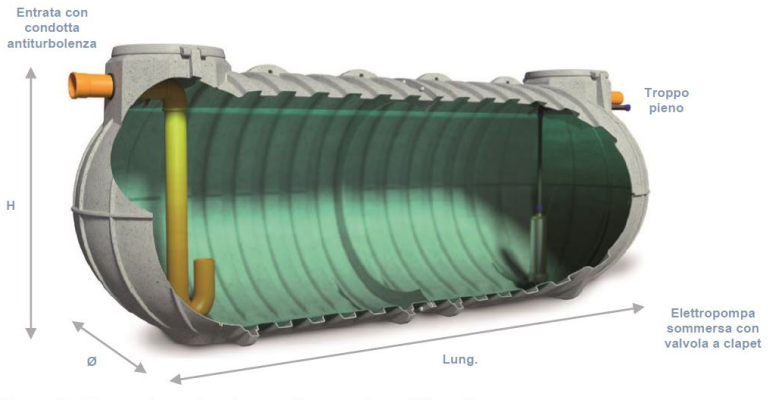
supply telescopic sprinklers, rain sprinklers, sprayers, and for all purposes requiring high operating pressure. Various pump models are available depending on the required head and flow rate.

Use and maintenance: For the proper functioning of the rainwater booster tank, it is essential to choose the pump suitable for the application during the design phase. Therefore, it is necessary to evaluate some technical parameters such as the head and flow rate of the pump, as well as the indication of the final use of the accumulated water (irrigation, washing). Under normal operating conditions, the electric pump does not require any maintenance. However, an annual inspection is recommended during which the liquid inlet is cleaned of any debris, and the condition of the electrical cable, pipes, fittings, and fastening devices is checked.
In the case of rainwater accumulation, it is recommended to install a leaf filter pit upstream of the tank to prevent the accumulation of gravel, sand, leaves, etc., inside the tank.

2.4.1. Technical data

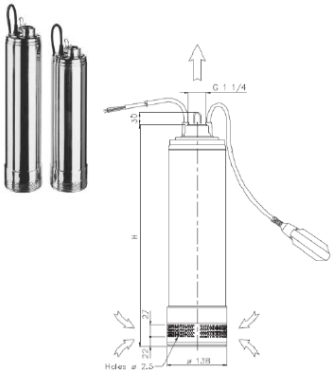
- Rainwater recovery tank for underground installation (volume ***50,000 liters***) with dual pump,
- Multi-stage filter (to be installed on the delivery side of the final distribution system) with manual backwash, with successive filtration grades of 90 microns (I stage) and 25 microns (II stage) with final treatment (III stage) on activated carbon capable of removing odors and colors that rainwater acquires on its way to the storage tank (pressure drop at maximum flow rate 1.7 bar),
- Control panel for three-phase dual pump with pressure switches, 24-liter expansion vessel, valves, probe, and rain control,
- The system is considered complete and installed to a high standard.

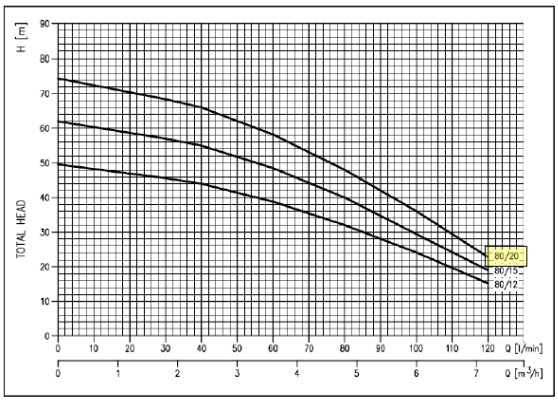
Material: modular underground container made of linear low-density polyethylene (LLDPE). The tank is equipped with: PVC inlet pipe (Ø 125mm) for water intake at the bottom of the tank and PVC overflow pipe (Ø 125mm) both with N.B.R. rubber gasket; 2 submersible electric pumps for boosting the recovered water pressure connected to polyethylene outlet pipes (2 x Ø 50 mm) including a check valve; electronic pressure switch for automatic pump control.



Applications: Handling of clear water from wells, cisterns, and primary collection tanks; Pressurization of domestic systems; Small irrigation; Vehicle washing; General pressure increases.
Technical features: Equipped with double mechanical seal with oil chamber; Supplied with 20 m of H07RN-F type power cable; Single-phase version with float on request (version "A"); Available in three-phase version 230V ±10% 50Hz; Installation: in horizontal and vertical position.

Pump technical data: Maximum operating pressure: 10 bar; Maximum liquid temperature: 40°C; Maximum immersion: 20 m; Maximum solids passage: 2.5 mm; Discharge connection G1¼.
Motor technical data: Asynchronous 2-pole self-ventilated motor cooled by the handled liquid; Insulation class F; Protection degree IP68; Single-phase voltage 230V ±10% 50Hz, three-phase voltage 230V ±10% 50Hz, three-phase voltage 400V ±10% 50Hz; Permanently installed capacitor and built-in automatic reset thermal-amperometric protection for the single-phase motor; User-provided protection for the three-phase version.
Materials: Outer casing, motor cover, seal carrier disc, filter, and locking ring in AISI 304; Impeller, diffuser, and spacer in PPE+PS reinforced with glass fibers; Shaft in AISI 431; Upper mechanical seal (motor side) in Carbon/Ceramic/NBR and lower (pump side) in SiC/Carbon/NBR.





Caratteristiche

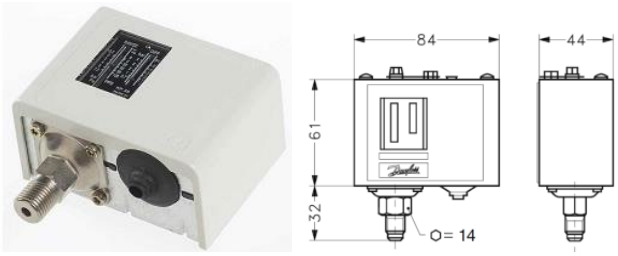
Modello pompa	Potenza		DNM (pollici)	H (mm)	Peso (kg)
	HP	Kw			
PI80/20	2	1,5	1" 1/4	590	18

Q (portata)							
l/min	20	30	40	60	80	100	120
m^3/h	1,2	1,8	2,4	3,6	4,8	6	7,2
H (prevalenza)							
mt	-	68,4	66,0	58,2	48,0	34,8	22,8

SS D 01/SS D 02 Submersible Pump for Dual Network Tank

- Type: *submersible*
- Quantity: *2*
- Unit characteristics:
    - Flow rate: *1.8 m³/h*
    - Head: *68.4 kPa*
    - Installed power: *1.50 kW*

Pressure Switch

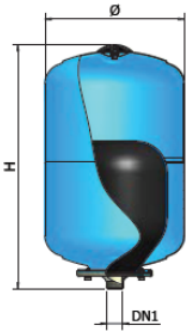


Pressure switch built in accordance with EN60947-4/-5 standard;

- Operating ambient temperature: from -40 to +65 °C;
- Protection: IP30;
- Electrical connection: cable entry from 6 to 14 mm;
- Max pressure: 17 bar
- Contact rating:
    - AC-1: 10 A, 440 V
    - AC-3: 6 A, 440 V
    - AC15: 4 A, 400 V
    - DC-13: 12 W, 220 V

Serbatoio a membrana

litri	Ppre (bar)	Pmax (bar)	Ø (mm)	H (mm)	DN1
24	1,5	8	270	470	1 "



• Prodotto omologato CE;
• Per acqua potabile;
• Temperatura di esercizio: -10 / +99 °C;
• Verniciatura a polveri epossidiche colore blu;
• Membrana intercambiabile in gomma EPDM;
• Completa separazione tra acqua ed aria;
• Completa separazione dell'acqua dalle parti metalliche del serbatoio;
• Membrana atossica alimentare intercambiabile con caratteristiche di elasticità tali da permettere una totale espansione all'interno del serbatoio per assicurare migliori prestazioni e una maggiore durata
• Dichiarazione di conformità ai requisiti essenziali di sicurezza previsti dalla direttiva 97/23/CE (PED).

Alternatively:

Supply and installation of a monobloc prefabricated reinforced concrete tank in C.A.V. with perfect sealing, to be buried, made with concrete RcK > 500 Kg/cm² with the addition of ventilated calcium carbonate filler and aggregates conforming to UNI EN 12620 (SELF-COMPACTING CONCRETE SCC type), adequately cured, exposed face, with total elimination of porosity and surface "honeycombs," having internal steel reinforcements with improved adhesion and square and rectangular mesh welded wire mesh type B450-C controlled in the factory, all in accordance with D.M. 14.01.2008. Other characteristics of the concrete: made with cement having exposure class XC4 (concrete resistant to carbonation corrosion), XS3/XD3 (concrete resistant to chloride corrosion), XA2 (concrete resistant to aggressive chemical environments), according to the prescriptions of UNI EN 206-1:2006.

The tanks are complete with a drive-over cover for heavy traffic (1st category road loads – 60Kn/m²) prefabricated in C.A.V. made with the same characteristics as the monobloc tanks.
Including openings on the cover for inspection and maintenance to be protected, including D 400 class spheroidal cast iron manholes adequately anchored.
The tank includes a sludge deposit compartment and a compartment for housing the water booster pump separated by a special partition in AISI 304 stainless steel, water accumulation area.
The supply includes the pumping system for boosting accumulated water consisting of a dual submersible cast iron pump with a recessed vortex impeller, complete with accessories, 2 flow regulators, 2 DN 50 check valves including hydraulic connections.

Main indicative characteristics of the single submersible pump:
- Flow rate: *1.5/5 l/s*
- Head: *3.5/5 m*
- Power consumption: *0.4 kW*
- Discharge diameter: *DN 50*
- Electrical supply: *400 V-three-phase*
- Including usage accessories, etc.

N.1 Control panel for the present electromechanical units, pre-programmed, protection degree IP55, interfaced with pre-installed level indicators (as per drawings) and cycle control timer and fault signaling devices, including an alternation device inserted in the control panel for alternating operation of the 2 submersible pumps at each start cycle (including provision for external socket connection 16 A -220 V).

Supply of 2 pre-installed coupling devices for quick extraction/re-coupling of the DN 50 pump to the discharge pipe, with upper guide tube anchoring, bolts, including hydraulic connections, pair of hot-dip galvanized steel guide tubes for pump handling including guide tube fixing brackets and extraction chain.
Supply of 1 flow regulation chamber with calibrated weir in CLS and AISI 304 stainless steel.
Supply of 2 flow regulation chambers with calibrated weir in CLS and AISI 304 stainless steel.

2.5. Thermal insulation

All vessels containing hot or cold water, whether located externally or internally including plant rooms, shall be insulated against freezing, overheating and condensation, including the underside where accessible.
Vessels shall be insulated with rigid slabs as specified, cut so that top and bottom overlap the sides. Insulation shall be bonded to the vessel by a suitable adhesive applied in accordance with the manufacturer's instructions. Slabs shall be closely butted together and joints sealed with 100 mm wide matching tape. Any exposed edges or penetrations shall be suitably sealed. The insulation shall then be covered with a purpose made jacket made of aluminium or aluzinc sheet. Where the tanks are mounted externally the sheets shall be sealed and weatherproofed.
Pipe headers and water boxes shall be insulated as described for pipework insulation with a tapered finish, to the equipment side of header valves and cocks. Equipment chests, flanges and the like, shall be provided with lined and removable boxes, formed from material to match the general insulation and finish, and to provide the same thickness of insulation as specified for the equipment.
The minimum thickness of thermal insulation must be determined using the methodology defined in the DPR 412 - allegato A.
Care must be taken to ensure that insulation meets all criteria namely, heat loss, condensation prevention, protection against freezing and personnel protection against burns. In all cases, the most onerous requirement shall prevail.

2.6. Connections

Connections to GRP tanks must be made strictly in accordance with the manufacturer's recommendations using materials and components supplied by the manufacturer and must in any case be two-piece PVC flange connections with mastic gasket and secured with stainless steel nuts and bolts conforming to type 316/A4 according to UNI EN ISO 3506-1.

All these types of tank connections must be provided with pipe support immediately after assembly to ensure that no load is transmitted directly to the connection assembly.

Connections to steel tanks must be factory-fitted before shipment and must be threaded flanges for screwed pipes up to and including 50 mm pipes and studded pads for flanged pipes of 75 mm and above.

Vessels shall be provided with bosses and connections for the following:

- Water inlet and outlet
- System make-up (if required)
- Temperature sensor(s)
- Pressure gauge
- Safety valve
- Drain valve
- Anti-vacuum valve (if required)

Flanged connections shall be to UNI EN 1092-1 "Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated", the DN pressure rating to suit the system design pressures.
Screwed connections shall be to UNI EN 10226-1 "Pipe threads where pressure tight joints are made on the threads".
Safety valve and drain valves shall be piped to a suitable discharge point, for example a gulley.

2.7. Site handling and storage

All vessels shall be provided with lugs or other suitable lifting points. If the vessel is pre-insulated, care must be taken to that the insulation is not damaged during transit or handling.
All damaged insulation shall be replaced.
Protective covers or plugs shall be provided on all connections or openings to prevent the ingress of foreign material.
Vessel shall be suitably stored on site to prevent damage or deterioration.

2.8. Site installation

All vessels shall be mounted on a level base.
Foundations must be suitably designed to prevent settling or structural damage.
Sufficient space must be provided so that the vessel can be fully inspected once the installation is complete.

All materials and work associated with the provision of the tank base or support on which the tank will be erected must be supplied and carried out by the contractor in accordance with the drawings produced by the tank manufacturer.
The contractor may not procure materials or carry out the work until the project management has completed the review of the detailed drawings.
The contractor must strictly adhere to the specific requirements requested by the particular tank manufacturer and must comply with the following minimum requirements:

Foundations: They must be constructed with engineering bricks or reinforced concrete with a minimum width of 200 mm. The walls must be built with centers of 500 mm arranged as required based on the length or width of the tank and must

exceed the overall dimensions of the tank by 150 mm at each end. The walls must be structurally designed to support the weight of the tank including the contents and must take into account the ground bearing conditions or the load limits of the floor construction. The applicable tolerances for the level of the walls will be 2 mm along the length of the wall and between the walls furthest apart and diametrically across the walls.

Steel structure: If steel sections are to be provided, the sections must be positioned at centers of 500 mm arranged as required for the length or width of the tank and must exceed the overall dimensions of the tank by 150 mm at each end. The steel sections must be selected to be structurally suitable to support the weight of the tank including the nominal contents, taking into account the ground bearing conditions or the load limits of the floor structure. The maximum allowable deflection of the steel section must not exceed 1/500 of the unsupported span. The applicable tolerance for the level of the steel sections will be 2 mm along the length of the wall and between the sections furthest apart and diametrically across the sections.

Concrete plinths: Only where externally flanged bases cannot be used, solid concrete plinths must be structurally designed to support the weight of the tank, including the contents, and must take into account the ground bearing conditions or the load limits of the floor constructions. The plinths must be at least 150 mm high and in length and width 300 mm longer than the overall dimensions of the tank including the flanges so as to create a plinth 150 mm wider around the ends of the tank. The top surface of the plinth must be smooth and level within 2 mm laterally or diagonally across the ends of the tank, without abrupt changes in level.

Bunded area: The lower level supports and waterproof membranes will be installed by the contractor in accordance with the architect's detailed drawings, complete with drainage channel.

2.9. Construction and start-up

The assembly of the tanks on plinths, thin walls, or steel constructed by the contractor will be carried out by the tank manufacturer.

The tank manufacturer must ensure that the plinths, thin walls, or steel supports for the tank strictly comply with the agreed installation drawings and that all construction tolerances meet their requirements and the requirements of this specification before the start of tank construction.
The contractor must always be present to ensure that sufficient access, lighting, and power are available for the work and that the activities of the tank builders do not hinder other site activities and that the highest standard of workmanship is maintained at all times.
Once completed, the constructed tank must be reported to the project management for inspection before any further work is carried out.
After an acceptable inspection by the project management, the tank can be filled with clean mains water to determine the hydraulic tightness of the installation. The hydraulic tightness test of the tank must be continuous for 24 hours during which the contractor will be present, as required, to address any joint failures that may occur during this period.
The contractor must issue a certificate to the project management to confirm the satisfactory completion of the test. Test certificates must be included in the documentation.
Where it is necessary to insulate the tanks, the insulation work must not be carried out until satisfactory hydraulic tightness of the tank has been achieved.
The sterilization procedures to be followed for the commissioning of the storage tank must comply with these Specifications.

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Heating/cooling units for non critical spaces
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

Document: A12 ES E CM 01-

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1. INTRODUCTION

This specification details the requirements for heating/cooling units for non critical spaces.

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications.

2. TECHNICAL FEATURES

2.1. Sizing and selection

The selection of equipment must meet the following conditions:

- External condition limits:
    - For "non-critical" areas: temperatures -5°C/+35°C, 30-70% RH
- Internal condition limits: 5°C winter setpoint

2.2. Power supply

All equipment must be suitable for the following types of power supply:

- 230 V single-phase 50 Hz
- 400 V three-phase 50 Hz

The power supply must be derived from a dedicated switch on the electrical panel, as specified in the electrical technical documentation.

2.3. Installation and performance

There must be no obstacles limiting access for routine maintenance.
This includes ensuring sufficient access through any suspended ceilings.

The manufacturer must be able to demonstrate that their units have been tested to achieve the specified noise level in accordance with the requirements. If noise levels are not specified, the noise levels described in the project report and *Annex 23* must be used.
When electric heating coils are present, an airflow switch wired to the heating coil must be present to ensure airflow before activating the electric resistances.
The units must have a thermal switch that resets automatically once the temperature drops to a preset level. In case of activation, a fault signal must be sent to the BMS system.

It is also necessary for the terminal unit to continue operating after reaching the set temperature to dissipate any latent heat within the unit. This must be a variable time interval from two to ten minutes. The exact time interval must be part of the commissioning process to ensure there is no heat buildup while minimizing operating time.

3. LIST OF HEATING TERMINAL TYPES

3.1. Electric air curtain

Air curtain barriers for installation heights from 3 to 5.5 m, for both horizontal installation above the door and vertical installation beside the door, in the version with high-efficiency EC motor. Configured for ventilation only with a housing made of white RAL 9016 painted steel sheet containing centrifugal fans. Aluminum fin, with an airfoil profile, installed on the air outlet with the possibility to adjust the throw from 0 to 90°.
Control system:

- Ambient version: 5 speeds and integrated shutdown timer with the possibility to manage automatic operation in combination with door contact and room thermostat. Electrical supply: Models with electric resistance: 400/50/3 (electric resistances) + 230/50/1 (motors and control). Motor protection rating:
- EC motors: IP54 for B-BB models; IP44 for M - G models.

On request:
- AISI 304 stainless steel versions
- Various RAL color options
- Vertical execution with horizontal air throw; requires a special base frame for floor installation.

3.2. Electric Fancoil

Covering cabinet in hot-dip galvanized and pre-painted sheet metal, with a reversible fixed-blade discharge grille. Heat exchange coil with armored electric resistances, in steel tube with continuous fins.
The capacity is divided into two stages to allow partial load operation.
On-board control with ON-OFF selector, speed selector, and thermostat.

Electro-fan group consisting of:
- Double inlet centrifugal fans
- Single-phase 3-speed electric motor, mounted on anti-vibration elastic supports
- Regenerable synthetic filter contained in a metal frame
- Control and monitoring electrical panel with all control, monitoring, and protection automations, auxiliary circuits with safety thermostats, and terminal block pre-arranged for line connections
- On-board control panel for changing ventilation and power

Technical characteristics:
- 230 V single-phase 50 Hz
- Electric power: 3 kW

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Pumps for building services
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

Document: A14 ES E CM 01-

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1. INTRODUCTION

This specification details the requirements for pumps.

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications

2. PUMPS – GENERAL FEATURES

Pumps shall be suitable for the operating temperatures and pressures of the system into which they are to be incorporated. Pumps and motor assemblies shall be balanced to minimise noise and vibration. Pump construction and arrangement shall be such as to prevent strain on connecting pipework and joints.

Casing
The impeller casing shall be manufactured from a material suitable for the working temperature, pressure and fluid being pumped as recommended by the manufacturer. No pump shall be used where not specifically recommended by the manufacturer for the intended service
The pump casing shall include methods for venting air and draining water for servicing
Pumps up to 50 mm diameter shall be provided with screwed connections complying with UNI EN 10226:1 "Pipe threads where pressure tight joints are made on the threads". Larger sizes, or where operating pressures dictate, shall be flanged to UNI EN 1092 "Flanges and their joints".
The casing shall be hydro-statically tested to 1.5x the rated maximum working pressure.

Impeller
Impellers shall be and manufactured from materials recommended by the manufacturer for the duty and be dynamically balanced to minimise vibration. Impellers on pumps serving domestic hot water systems shall be gunmetal.

Shaft and seals
The pump shaft shall normally be stainless steel unless otherwise recommended by the manufacturer. It shall be capable of transmitting the torque to the impeller during start up and operation.
The shaft and impeller shall be capable of being withdrawn without disturbing pipework connections.
Pump seals must be suitable for the fluid being pumped. Particular attention should be made to systems with glycol, aggressive water supplies such as de-mineralised and high operating temperatures in excess of 100°C where the manufacturers' advice must be sought.

Performance
When selecting pumps the Contractor shall ensure that the unit selected has the best possible efficiency for the duty. In all cases the pump shall have a minimum efficiency of 70%. In order to maintain maximum efficiency, all pumps shall be provided with motors that do not require the motor to be overloaded. Guidance is given below on the excess capacity of motors relative to duty.

2.1. Motors

I motori delle pompe devono essere conformi ai seguenti requisiti:
Pump motors shall comply with the following requirements:
Motors shall be suitable for ambient operating conditions of between -30°C and +40°C.
All pump motors shall be motor class EFF1 or 2.
Unless otherwise stated all three phase motors shall be 4 or 8 pole.
Motor enclosure shall have a minimum penetration rating of IP 55 installed internally where and minimum IP rating of 65 for externally mounted pumps

The maximum noise level of any pump motor shall be 70 dBA. Acoustic performance shall comply with UNI EN ISO 20361 "Liquid pumps and pump units. Noise test code. Grades 2 and 3 of accuracy".
All motors shall have internal thermal protection.
Motors below 1 kW rating shall be single phase. 1 kW and larger sizes shall be three phase.
Motors shall have a minimum spare capacity above the driven power of the pump taking into account drive losses as follows:

- Up to 7.5 kW 33%
- 7.6 to 15 kW 25%
- 15.1 to 30 kW 20%
- Above 30 kW 15%

2.2. Maintenance and access

The Contractor shall make due provision for access and maintainability of the pump and motor.
All pump motors shall be installed in such a way that they can be easily removed. On motors in excess of 25 kw rating the Contractor shall provide a permanent lifting beam for motor removal or provide a method statement on how this should be achieved and gain the agreement of the deign team.
In line pumps shall be installed in such a way that the pump motor an impellor can be removed without disturbing the pipe work.

2.3. Rated duty

The Contractor shall, after final selection of all equipment, including control valves, and on completion of the Working Drawings, check that the pump heads are adequate to meet the system requirements before ordering the pumps.
Pumps shall be capable of providing the duties required at the design operating conditions.
Pumps shall be selected to ensure that they are operating at their best efficiency point and to allow the flow rate to be increased by a minimum of 10%, corresponding to a 21% increase in pressure, such that stable operation is achieved and no undue fluctuation of flow quantity is experienced for small pressure changes.
Performance curves showing head, volume flow rate, efficiency and absorbed power of each pump shall be provided prior to equipment being ordered. Curves showing the Net Positive Suction Head (NPSH) over the full pumping range shall also be provided. The data shall be related to pump speed to allow the effect of speed changes to be assessed.
Pump performance shall be tested in accordance with UNI EN ISO 9906 "Rotodynamic pumps. Hydraulic performance acceptance tests. Grades 1, 2 and 3".
Pumps to be used for pumping liquids other than clean water (e.g. glycol mixtures) can be tested using cold clean water as detailed in UNI EN ISO 9906 if the characteristics of the liquid are within the ranges given below.

Characteristics of liquid	Unit	Min	Max
Kinematic Viscosity	m^2/s	No limit	10×10^{-6}
Density	kg/m^3	450	2000
Non-absorbent free solids content	kg/m^3	-	5.0

2.4. Controls and starting

Unless otherwise stated ALL pumps shall be provided with frequency inverters for both flow control to regulate the duty and soft starting.
Where it has been agreed with the Engineer that inverters shall not be provided alternative methods shall be employed to limit the starting current:

- Direct Online up to 5 kW
- Star Delta 5 kW and above

The normal control policy shall be remote starting of the pumps via the building management system. Suitable BMS points shall be included for speed control of the pump, flow monitoring via DP sensor, and pump operation fault from the inverter.
PUMP FITTINGS AND ANCILLIARIES
Unless otherwise stated all pumps shall be fitted with the following:

- Suction and discharge isolating valves.
- Discharge non-return valve.
- Inlet strainer.
- Pressure gauges on suction and discharge between isolating valves to measure closed head pressure.
- Suction and discharge flexible connections.
- Permanently connected differential pressure sensor across suction and discharge for BMS monitoring purposes.

2.5. Installation

The Contractor shall ensure that the following requirements are met during the construction process.

Storage
Prior to installation, all pumps shall be fitted with pump port protection plates to prevent excessive rusting or ingress of foreign matter.

Handling
The pumps shall be lifted in accordance with the manufacturer's recommendations. The motor lifting eyes shall be used for lifting the motor only and shall not be used for lifting the complete unit.

Orientation
Glandless circulation pumps shall be installed with the shaft horizontal.

Pipework Connections
Connecting pipework shall be provided with screwed connections complying with UNI EN 10226 "Pipe threads where pressure tight joints are made on the threads" or flanged connections complying with UNI EN 1092 "Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated" to suit the pump connection size and type.
A straight section of pipe of length equivalent to 6 times the diameter of pump suction inlet shall be installed on the suction side of the pump. Alternatively, suction guides can be used to reduce the length of connecting pipework.
Valves and strainers shall be pipeline size, and not connection size, to minimise flow resistance.
Where pumps are required to operate as duty/standby, a non-return valve shall be installed on pump discharge to prevent recirculation of flow through the standby pump. Non-return valves shall be selected to have a low resistance to flow.

Pumps shall be installed such that the pump or pipe work weight is not borne by the flexible connections on inlet and discharge. Flexible connections shall not be installed where the pump is to be supported from the connecting pipework.
Pipework shall be supported independently of the pump. All supports within 3 metres of base mounted pumps with motors exceeding 15 kW shall be spring anti-vibration type and shall comply with the manufacturer's recommendations.
All valves, fittings and supports shall be selected and installed in accordance with the Black & White Engineering Standard Mechanical Specification.

Gauges
Pressure gauges shall be installed either side of the pump for monitoring of inlet and discharge static pressure and the differential pressure across the pump. The selection and installation of pressure gauges shall be in accordance with the Black & White Engineering Standard Workmanship and Materials Specification.

Inertia Base
Where indicated and all pumps exceeding 5 kW mounted on a suspended or intermediate slab shall be provided with an inertia base.
The inertia base shall comprise a steel frame concrete filled on site with concrete and suspended above the slab on anti-vibration mountings.
The Contractor shall be responsible for selecting the correct anti-vibration mounts to suit the combined weight of the pump and inertia base.
All pipe work connected to the pump within 10 m of an inertia base shall have spring hangers to prevent transmission through the pipe work.

Electrical Connections
All pump motors shall be provided with a local isolator rated to suit the motor maximum load.
This should be mounted in an easily accessible position normally in front of the motor insulation
Pump impellor casing shall be insulated where indicated and on all MTHW and HTHW pumps to prevent burning.
Where indicated chilled water pump impellor casings shall be insulated and vapour sealed
Commissioning
Reference should be made to the Black & White Engineering Standard Specification for Commissioning.
Spares
Spare seals, packing and drive couplings shall be provided and handed over to the Employer on completion. The spares shall be of the correct size and sufficient quantity to re-pack and replace every seal, gland and coupling of all pumps provided.

3. TYPES OF PUMPS AND TECHNICAL FEATURES

3.1. Centrifugal water pumps

3.1.1. Technical features

Centrifugal inline pump, suitable for pumping water in heating and air conditioning systems, with a cast iron body and stainless steel impeller; with inline suction and discharge ports suitable for installing the pump on pipes or on a support base. Mechanical seal made of corrosion-resistant material. Coupled with an electric motor type MGE 3fx400V/50Hz equipped with a micro static frequency converter and pre-wired and pre-set differential pressure transducer; complete with integrated overload and overtemperature protection. Protection class IP55 and insulation class F. Suitable for wiring external sensors for operation through the following parameters: flow rate, differential pressure, or temperature. The following additional specifications apply:

- Pump body: made of cast iron, with flanged connections, must be suitable for operating with pressures of 16 ATE and designed to allow, if necessary, the installation of an impeller with a diameter larger (by at least 8%) than the one supplied with the unit;
- Inlet and outlet connections (suction and discharge): must be flanged in PN 16 execution: each must be complete with a welding collar counterflange, with gaskets and bolts;
- Pump body: must be able to withstand, applied to the flanges of the suction and discharge ports, a load corresponding to the weight equivalent to 1 meter of pipe (and related thermal insulation) of the same diameter as the circuit in which each pump is installed;
- Impeller: made of stainless steel, must be of the backward-curved blade type and such as to achieve a characteristic Q/H curve without unstable operating sections (i.e., sections where Q and H increase or decrease simultaneously);
- Impeller: must be keyed to the shaft and locked to ensure the stability of the connection under all possible operating conditions: the "impeller/shaft" connection must be of the detachable type;

- Connection: must be sized for continuous and intermittent operation (6 starts/hour): the torque withstandable under safe conditions must be equal to the maximum deliverable by the electric motor (counter-phase start);
- Seal between shaft and pump body: must be made with a packing system complete with an adjustment device;
- Flexible coupling: made of cast iron, complete with anti-tear devices, must be sized to transmit the maximum power deliverable by the electric motor (counter-phase start). Type suitable for disassembly and reassembly without the need to intervene on the alignment between motor and pump;
- Rolling bearings: both those of the pump body (if not of the plain bearing type) and those of the electric motor must be sized for a "life" of not less than 50,000 hours;
- Electric motor: asynchronous three-phase type, with DC rotor, direct insertion start, must have a nameplate power suitable for operation with the installation in the pump body of an impeller of larger diameter (see above) and with the unit running with an open port;
- Metal base: type suitable for floor mounting must have sufficiently high rigidity characteristics to withstand, once installed, all the stresses resulting from the transfer of mechanical energy to the pump.

The above must be achieved without elastic (or inelastic) deformations that could alter the alignment between motor and pump or abnormally stress the components involved in the transmission of motion (shafts, coupling, supports).
The base will be equipped with a safety device to protect the rotating parts external to the pump body and the electric motor (shaft ends and flexible coupling): this protection will comply with the current ISPESL regulations.

3.1.2. Immersed Rotor Circulators

Circulator of the separator sleeve type with a wet rotor, pump and motor form a single unit without mechanical seal and with only two gaskets, suitable for pumping water in heating and air conditioning systems, with cast iron body and stainless steel impeller and separator sleeve. Asynchronous three-phase motor. Insulation class H. Characterized by:

- Integrated differential pressure control
- Ceramic radial bearings
- Aluminum alloy stator housing
- Stator with built-in thermal protection Based on the set point, the differential pressure is automatically controlled as the system load varies without external components, with proportional or constant pressure regulation modes.

3.1.3. Accessories

- For flanged connections: counterflanges, bolts, and gaskets; for threaded connections: sleeves and three-piece couplings to allow pump disassembly;
- Series of truncated conical fittings for connections to the suction and discharge ports;
- Pressure gauge as specified, with a three-way male valve (alternatively two two-way valves) installed across the ports, complete with pressure gauge holder with three-way valve, test flange, and spiral;
- For single-stage pumps with axial suction and radial discharge, directly coupled or with coupling, for base installation provide anti-vibration supports or anti-vibration neoprene mat to be inserted in the concrete base, to be selected as prescribed in the section "Measures against vibration transmission"; for single-stage pumps with inline ports, directly coupled, for horizontal base installation or for vertical shaft multistage pumps provide anti-vibration neoprene mat to be inserted between the steel base plate and the concrete base, to be selected as prescribed in the section "Measures against vibration transmission";

- Fixing bolts and any anchor bolts to be inserted in the concrete base;
- Tags indicating the pump code and the served circuit, made of galvanized steel or plastic material with a protective transparent plexiglass screen; the equipment codes must be consistent with those of the electrical panels and with the identifications of the as-built documentation.
- For electronic pumps, provide interface module for connection to the BMS supervision system.

3.1.4. Installation Methods

The installation of the electric pumps must be carried out with great care to achieve perfect hydraulic, mechanical, and electrical operation; in particular:

- Pipes and valves must not exert pressure on the pump ports;
- Allow disassembly and reassembly without tampering with the connection pipes;
- Mounting designed and constructed to make access to various parts easy both for operations during use and for maintenance;
- Ensure perfect horizontal (or vertical) leveling of the electric pump axis on the support base;
- Prevent any transmission of noise and vibrations, either by interposing suitable damping material or by adequately selecting the characteristics of the electric motor, which must in any case be of the four-pole type;
- Pumps fixed to structures using anti-vibration devices; the connection to the pipes must always be made with anti-vibration joints;
- For single-stage pumps with axial suction and radial discharge, directly coupled or with coupling, a concrete base must be made, inserting a sheet of resilient material (neoprene or similar) of adequate thickness in a "sandwich" in the concrete. Direct contact between the upper and lower parts of the concrete must be avoided;
- For single-stage pumps with inline ports, directly coupled, for horizontal base installation or for vertical shaft multistage pumps, a concrete base must be made by inserting an anti-vibration neoprene sheet under the support plate;
- Pump drains, seals, and (if any) filters conveyed into special sumps with galvanized steel pipes conveyed to the prepared drain pits;
- Insert silent check valves or other types with equal or better characteristics on the discharge pipe;
- Calibration valve on the discharge or return of the circuit;
- Shut-off valves upstream and downstream of the pump;
- For parallel pumps, check valves on the discharge;
- Always provide a suction filter on the primary circuits to the pumps;
- Ensure full compliance with CEI standards, both for grounding and for the electrical system. It should be noted that reserve electric pumps must always be installed: each electric pump will be interceptable with the operation of appropriate exclusion gate valves.

3.1.5. General Notes

All data, characteristics, and performances indicated are the minimum allowed and should be considered valid unless otherwise indicated in the attached tables. The heads must be verified by the Contractor during installation, in relation to the actual development of the circuits, the installed line components (shut-off and control valves, filters, joints, etc.), and the pressure losses of the actually installed equipment.

3.1.6. Testing

List of tests:

- On-site measurement of water flow rates by detecting pressure losses at the calibration valve(s);
- On-site measurement of pressure difference across the electric pumps;
- On-site measurement of electric pump power consumption;
- Verification on the electric pump diagrams of the consistency of the detected data.

3.1.7. Warranties

The manufacturer will guarantee that the pump units and all supplied materials will comply with safety standards and meet the specifications outlined in this document. The perfect operation of each individual element of the entire supply will be guaranteed for a period of 12 months from the date of commissioning; however, not beyond 18 months from the factory test, should there be delays in commissioning not attributable to the supplier. These guarantees extend to subcontracted equipment. During the warranty period, the supplier will undertake to replace and/or repair, at their own expense, all parts that prove defective due to quality or design, construction, and/or assembly errors. All expenses related to warranty work will be borne by the supplier. For any replaced parts, the warranty will start from the date of replacement. The client reserves the right to reject the supply if it does not comply with the specifications outlined in this document.

3.1.8. Control Panel for Electronic Pumps

Where specified or required, a dedicated wall-mounted control panel must be provided in accordance with the latest edition of the Italian Standards. Protection against both direct and indirect contact must be provided with fully insulated and shielded terminations, if necessary, and by a differential switch to ensure automatic disconnection of the incoming mains supply in case of a ground fault. A weekly timer must be provided to turn off the pump control circuit when necessary. Suitable indicator lights and voltage-free remote contacts must be provided regarding the status of the timer relay. Setting the timer is the responsibility of the contractor along with the technician. A 100 mm dial pressure gauge must be positioned upstream and downstream of the circulation pump(s).
Control panel for systems with 1 to 4 pumps, with presettable Δp-c or Δp-v operating modes, suitable for wall installation, for automatic modulating performance control for wet rotor pumps and ventilated motor with integrated frequency converter.

- Control system for continuous speed regulation of the pumps
- Performance distribution on up to 4 single pumps
- Nominal power up to 22kW
- Speed regulation range between 100% and 40%
- Includes device for integral motor protection. The device controls pumps equipped with a frequency converter for modulating speed regulation. The system's differential pressure is controlled and regulated according to the varying load conditions of the system through a signal transducer. The control device acts on the frequency converter, thus regulating the motor speed. The speed variation modifies the pump head and consequently the related energy consumption. Additionally, pumps are activated or deactivated based on demand. Available functions:
- PID controller
- Lockable main switch
- LCD graphic display for viewing values and operating states
- Red button technology (one-button operation)
- LEDs for indicating operating status, pump(s) in use, pump(s) in block
- Protection switches and output terminals for pump power supply

- Integrated signaling board
- Automatic pump exchange
- Emergency operation capability
- Reserve pump selection The pressure transducer provides the actual differential pressure value in the form of a 4-20mA current signal. In the absence of "Remote Shutdown" signals or faults in the system, at least one pump is in operation.

The pump speed depends on the thermal load of the system. If the load demand cannot be met by a single pump, the second pump is activated and regulated according to the required load until the set pressure value is reached. Any pumps already in operation are kept active at maximum speed. If the demand drops to the point where the regulated pump operates in the low load zone and is no longer needed to meet the demand, it is deactivated, and load control is transferred to one of the pumps that previously operated at maximum speed.
The Δp-c and Δp-v control modes can be preselected within the menu. In Δp-v mode, only the first pump is controlled, and if other pumps are activated, they will be regulated based on the Δp-c curve.
Control and signaling functions: For integration into the customer's control and remote management systems, the system is equipped as standard with multiple control and command inputs/outputs:

- Analog output (0-10VDC) for the emission of the actual value provided by the differential pressure sensor
- Remote on/off with potential-free contact
- Cumulative lock signal SSM with potential-free changeover contact
- Cumulative operation signal SBM with potential-free changeover contact
- Individual lock signal ESM for each pump, with potential-free changeover contact
- Individual operation signal EBM with potential-free changeover contact.

3.1.9. Sinusoidal Motor Protection Filter for Pumps

Sinusoidal and dU/dt output filters are recommended for enhancing motor protection in applications with short motor cables, older generation motors, frequent braking, and aggressive environments.
Product features/advantages: dU/dt Filter:

- Up to a cable length of 100 m (shielded/unshielded), the requirements of IEC 60034-17* (universal motors) are met. Beyond this cable length, the risk of "double impulse" increases.
- Insignificant reduction in motor bearing stress, mainly in high-power motors.
- Prevents network feedback. Does not change the emission class. Does not allow longer motor cables as provided for the integrated RFI filter of the frequency converter.
- Maximum motor cable length of 100 m…150 m. With guaranteed power for electromagnetic compatibility: 150 m shielded. Without guaranteed power for electromagnetic compatibility: 150 m unshielded.
- Does not eliminate motor switching noise.

Sinusoidal Filter:

- Provides a sinusoidal voltage at the motor terminals phase-to-phase. Meets the requirements of IEC 60034-17* and NEMA-MG1 for universal motors with cables up to 500 m (1 km for size D and above).
- Reduces bearing currents caused by circulating currents. Does not reduce synchronous currents (shaft currents). Prevents network feedback. Does not change the emission class. Does not allow longer motor cables as provided for the integrated RFI filter of the frequency converter.

- With guaranteed power for electromagnetic compatibility: 150 m shielded and 300 m unshielded (only cable-related emissions). Without guaranteed power for electromagnetic compatibility: up to 500 m (1 km for size D and above).
- Eliminates motor switching noise caused by magnetostriction.

3.1.10. Pump Frequency Converter

Independent frequency converter for fixed-speed pumps used in variable speed applications, particularly for heating, air conditioning, and water pressurization. **Product features/advantages:**

- Compact construction with energy-saving cooling plate to reduce temperature losses
- High energy efficiency integrated oscillation reduction and additional energy-saving operation at partial pump load
- Various pump utilization possibilities thanks to different connection options and regulation modes
- Simple commissioning thanks to the intuitive assistant with graphical user interface

Options:

- External communication via IF modules (optional): Profibus, DeviceNet, Profinet, Ethernet, Modbus

3.1.11. Differential Transducer for Pumps

Sensor with mounting elements for modulating speed control based on differential pressure. With a 5 m connection cable to the control device; longer distances must be extended by the client:

- Up to 25 m: 3 x 0.75 mm², shielded.
- Up to 250 m: 3 x 1.5 mm², shielded. **Note:** Not usable with VR-HVAC

Supply:

- 1 differential pressure transducer
- 2 cutting ring fittings DIN 3862 Ød = 6 mm
- 2 cutting ring elbow fittings R 1/8 x Ød = 6 mm
- 5 m connection cables to the control device (3 x 0.34 mm²)
- 1 support for the differential pressure transducer
- 2 screws for fixing the differential pressure transducer
- Copper spiral required by the client

3.2. Circulation Pumps for Domestic Hot Water

Reference should be made to the project documentation for the specific pump requirements where details on the pump's dimensions, type, and performance must be provided. At all stages of construction until the delivery of the equipment, in perfect working order and commissioning as part of one or more systems, the equipment must be fully protected against damage to components and paint finish. The pumping unit must be manufactured by a company using a quality system approved according to UNI EN ISO 9001. The pumping equipment must be produced by Grundfos Pumps Limited or an equivalent and approved manufacturer. In general, HWS pumps will be fully assembled standalone units comprising service and standby pumps mounted on a prefabricated steel wall bracket complete with copper piping and a wall-mounted remote control panel. The pumps must be finished at the manufacturer's plant with a suitable corrosion-resistant undercoat and a topcoat with a glossy or hammered finish in the manufacturer's livery. At the end of the commissioning process, a commissioning or test certificate must be issued in duplicate along with a fully detailed checklist.
Unless otherwise specified, wet rotor circulators will be of the inline type with a bronze or brass body, and a stainless steel shaft and impeller. Alternative construction materials may be acceptable provided the complete pump unit complies with Italian regulations for use in potable water systems. The maximum pump speed will be 2,900 rpm. All pumps must be three-

phase or single-phase industrially quiet, as indicated elsewhere in the project documentation. The pump flow must be regulated by a mechanical flow control valve on the outlet of each pump.

The complete pump units will include suction and discharge shut-off valves, discharge check valve, and suction "Y" filter. The suction and discharge piping of each pump must be equipped with a suitably sized pressure gauge assembly, complete with shut-off valve and drain valve. Electric motors must be of the totally enclosed, ventilated type, compliant with CEI EN 60034-1 and the relevant sections of CEI EN 60034-1 with insulation class. The minimum motor protection will be IP40 unless otherwise specified. Motors must be suitable for direct-on-line starting.

3.3. Submersible Water Lifting System

The submersible water lifting systems will consist of:

- Two or more submersible electric pumps with a body and impeller made of grey cast iron GG-25, suitable for both black and white water, with a steel motor shaft and mechanical seals on both the impeller and motor sides. The impeller will be of the vortex type, suitable for fluids containing suspended solids and long fibers, and will be suitable for lifting both civil black water and untreated rainwater.
- An electrical panel complete with electrical protections for each user and auxiliary circuits to perform the functions described below, with an IP44 protection rating.
- Float switches made of corrosion-resistant material for pump control and maximum pit level signaling, which can be reported remotely.
- A support base with a connection for the discharge port and lifting devices from the fixed position.
- A check valve and a cast iron gate valve for each pump, with a nominal diameter equal to that of the pump's discharge port.
- Black steel pipes of appropriate size, based on the diameter of the discharge port, and in the necessary quantity to reach the indicated gravity discharge point.

Each pump group, including one reserve pump, must operate automatically, controlled by the float switches through the control panel, which will perform the following functions:

- Alternation at each start
- Additional insertion of the reserve pump
- Switching of the reserve pump

The pumps will be installed submerged; extraction and repositioning for maintenance will be done without accessing the pit, using two parallel stainless steel ropes along which the guides of each pump slide, pulled or lowered by a chain attached to the pump and secured at a point accessible from the pit cover. The seal between the pump and the fixed base is achieved by the weight of the pump itself, through an elastic connection.

3.3.1. Pressurization Units

Reference should be made to the project documents for the specific pump requirements where details on the dimensions, type, and performance of the pump units must be provided. At all stages of construction until the delivery of the equipment, the equipment must be fully protected against damage to components and paint finish and maintained in perfect working order and commissioning. The pressure boosting unit must be manufactured by a company using a quality system approved according to UNI EN ISO 9001. The packaged pressure boosting equipment must be produced by New Haden Pumps Limited or of equal quality/performance and subject to the approval of the project management. In general, booster pumps must be fully pre-assembled standalone units comprising a number of main service pumps with automatic standby (with or without pilot pump assistance) mounted on a steel base plate complete with hydraulic accumulator, interconnecting copper piping, and a control panel with complete wiring for operation. The complete package must be finished at the

manufacturer's plant with a suitable corrosion-resistant undercoat and a topcoat with a glossy or hammered finish in the manufacturer's livery. The pump manufacturer's method statement on commissioning procedures must be issued by the contractor to the engineer before the equipment is shipped to the site and the sequence of this operation must be demonstrated to the manufacturer's engineer. This will be the responsibility of the manufacturer. Factory test certificates and the manufacturer's pump performance curves must be made available for review by the technician. The pressure unit must be commissioned by the manufacturer. A commissioning or test certificate along with a fully detailed checklist must be issued in duplicate after the completion of the commissioning process. The contractor must provide all materials and carry out all work to provide a concrete base, if necessary, for the packaged pumping equipment. The size must be the minimum required by the manufacturer when issuing their certified drawings for the equipment and must have a minimum depth of 200 mm. The contractor will be responsible for providing and determining the position of the pockets for fixing the bolts for assembly, based on the information provided by their subcontractors.

3.3.2. Electricity supply

Tutte le apparecchiature devono essere adatte per un'alimentazione elettrica, un voltaggio e una frequenza locali standard. I requisiti del motore sono identificati negli abachi.
All equipment shall be suitable for a standard local electrical supply, volt and frequency. Motor requirements are identified in the schedules.

3.3.3. General

The pressurisation unit shall form a complete package, it shall be capable of both maintaining the design system pressure and of accepting the expansion volume of the system between its normal operating temperature and the initial fill temperature.
The unit shall comprise expansion vessel or vessels, run and standby pumps, break/fill tank and all relays, contactors and controls, interlocks and ancillary equipment necessary to maintain the system operating conditions.
The unit shall be installed in accordance with the manufacturer's instructions and be suitable for the system to which it is to serve, including the chemicals that are to be used within the system.

The integral break tank shall be manufactured from UPVC or GRP and shall be provided with a loose cover and the following fittings:

- Ball valve with type AA or AB air break
- Drain valve
- Overflow warning pipe
- Pump suction pipe with strainer.

The unit components shall generally be mounted on a steel base frame with a corrosion resistant powder coated finish.
In noise sensitive locations, the unit shall be located on anti-vibration mountings or an inertia base.
The maximum working pressure of the vessels shall be a minimum of 10 bar unless otherwise stated.

3.3.4. Sizing

The unit shall handle the full expansion volume of the system from normal cold fill, or ambient conditions, to normal working temperature. A margin of 5% for all water systems without spillage shall also be included.

3.3.5. Expansion vessel

The expansion vessel must be constructed in accordance with UNI EN 13831 where applicable and must comply with Italian regulations for use in potable water systems. The vessel must be suitable for the system's operating pressure and tested at least 1.5 times the maximum operating pressure.

The expansion vessels shall contain a removable butyl rubber sac or diaphragm enclosing a permanent pre-charged air cushion.
Vessels shall be constructed from steel and all parts in contact with water shall be treated against corrosion. External surface shall have a powder coat finished.
Each vessel shall be fitted with a Schrader type valve for filling.
All vessels shall comply with 2014/68/EU Pressure Equipment Directive (PED)
Vessels shall be provided with removable access ports to enable internal inspection and maintenance.
Vessels shall be provided with an information plate, permanently attached giving design information as required by 2014/68/EU Pressure Equipment Directive (PED).

Individual test certificates for any hydraulic accumulators incorporated into the pressure unit are provided upon request at no additional cost to the customer. Requests must be made before the start of the production processes. The vessel must be sized to maintain the number of service pump starts between 10 and 12 per hour. The hydraulic accumulator must be mounted on the pump base and form an integral part of the pressurized water system. Remotely mounted vessels will not be allowed unless written consent is granted by the technician due to overall size or severe space limitations.

3.3.6. Pimps

The pumps shall be provided with totally enclosed fan cooled motors with class F insulation.
All pumps shall be direct driven.
On sets with motors exceeding 1 kW motor starting shall be by inverter.
The pumps must be independent vertical multistage centrifugal pumps with cast iron/stainless steel casing sections, stainless steel impellers, stainless steel shafts, water-lubricated rubber bearings, neck rings, etc., and mechanical seals coated with tungsten carbide.
The motors will be totally enclosed and fan-cooled, directly coupled to the pump to form an integral unit. Each pump must have separate shut-off and check valves with an additional shut-off valve on the final discharge. Fully assembled manifolds for both suction and discharge, made of copper or stainless steel as required, as detailed.
The 100 mm dial pressure gauge will be connected to the discharge manifold.
When the system requires an increase beyond the maximum speed of the first variable speed pump for a preset time, the next variable speed pump automatically comes in to assist the first, and so on. When demands decrease, the pumps ramp down until the system can be shut off. The pump sets and pipework wiring, along with the control panel and pressure vessels, must be fully assembled on a common base frame with all interconnecting cables between electrical components.

3.3.7. Pannello di controllo e controlli

Control panels shall contain the motor starters, operating and safety controls and all interconnecting wiring.
The panel shall be a minimum of IP54 rated with lockable door and interlocked isolator, visual indication of system pressure and pump status.
The following controls and components shall be provided:

- Pump starters and automatic changeover.
- Pressure switches to control system operation.
- Low and high-pressure alarms.
- Volt free contacts for external status to BMS.
- Visual indication of system pressure.
- Unit fault lamp.
- Inverter control of lead pump where specified.
- Automatic lead pump changeover.
- Hours run metering of pumps.

The control panel housing the inverters and other control equipment must be constructed from steel sheet forming a single enclosure that protects against dust and moisture, with a polyester powder-coated finish and a hinged front door with a lock.
The control system will be designed to control two, three, or four pumps, in standby service format, automatically rotating the main variable speed pump on a preset time cycle. Pressure control will be achieved via a signal from pressure transducers mounted in the piping to maintain the preset pressure through the pump inverters.
All settings must be programmable to make the system flexible and reliable. The main pump will be automatically changed via a programmed timer.
Standard features will include: status and fault LED indicators, manual device, automatic device, drive configuration, and electronic pump protection and isolation. The electronic board formats all control output signals as 12 V DC.
Voltage-free contacts for remote monitoring are to be included.
The electronic panel must be designed in accordance with the latest edition of CEI standards. Protection against both direct and indirect contact must be provided with fully insulated and shielded terminations, if necessary, and by a differential switch to ensure automatic disconnection of the incoming mains supply in case of a ground fault.
An interlocked four-pole isolator must be incorporated into the incoming mains supply. A tank level monitoring system comprising electrode relay control devices without high and low level float and associated secondary relays and lamps must be incorporated into the control panel.
Each tank section (where applicable) must be monitored separately, with each tank isolated from the monitoring circuit by a panel-mounted selector switch. Voltage-free contacts must be provided for both high and low level conditions.
An audible alarm with a mute button function, activated by any trip or abnormal level condition, must be provided.

3.3.8. Connecting pipework and fittings

The pressurisation system shall be provided with the following connections and fittings:

- Mains water fill line with stop valve and water meter
- System fill line with isolating valve and thermal siphon
- Electrical supply with isolator
- System pressure gauge
- Tank overflow taken to suitable drain
- Pressure sensor for remote BMS monitoring
- Quick fill point.

Please note that the Water Byelaws do not permit permanently connected quick fill lines. This must be a disconnected hose, stored nearby, with an isolating valve and hose union on the system and an isolating valve with hose union and an RPZ valve on the mains supply.

3.3.9. Piping, Valves, and Meters

All pump and manifold piping must be constructed with copper tubing according to UNI EN 1057 for capillary tube.
The fittings and pipes must be suitable for use with potable water and have adequate dimensions and strength to minimize system losses. All shut-off and check valves must be suitable for use in potable water systems. Screw valves must be sealed using a method compliant with Italian regulations.
The joining methods for copper pipes and fittings must also comply with Italian regulations. Unless otherwise specified, the manifolds must be terminated with UNI EN 1092 PN16 flanges.
The pressure switches used for pump control must be suitable for use in potable water systems.
The switching mechanism must be capable of switching the electrical load and be adequately protected against the ingress of dirt and water.
A suitably scaled panel-mounted system pressure gauge must be provided.

3.3.10. Spill systems

Spill systems shall have an atmospheric pressure spill tank to accept the expanding water content of the system from its initial temperature (normally 10°C) to its operating temperature.
The entire contents shall be captured by the spill tank to prevent contaminated water overflowing into the drainage system.
On loss of pressure the spill tank contents shall automatically re-charge the system back to its operating pressure. System pressure variation shall not exceed 0.6 bar.
The system shall comprise:

- Control panel with pump starters and control components
- Spill tank or vessels
- Expansion vessel(s)
- Interconnecting pipe work
- Automatic operating and safety controls
- Base frame
- Safety valve(s)

Where operating temperatures exceed 90°C, pre-cooling vessels shall be used to cool the water entering the spill tank.
Where spill tanks are used these shall be constructed from galvanised steel and have the following:

- Cover
- Thermal insulation
- Ball valve with type AB air gap
- High and low-level sensors and alarms
- Drain valve
- Overflow and warning pipe
- Spill valve

Arrangements where spill vessels are used shall a break tank and each vessel shall be supplied with a drain valve and an automatic air vent.
All the components of the spill system shall comply with relevant sections of the preceding paragraphs.

3.3.11. Auxiliary equipments

The manufacturer of the pressure unit must provide as part of the assembled pumping unit:

- Flanged flexible joints UNI EN 1515-1 / UNI EN 1092 PN16 minimum for isolating the piping systems from the equipment on both the suction and discharge connections.
- Composite rubber anti-vibration supports appropriately sized for the maximum wet weight of the pressure unit.
- Tank level control electrode breaks complete with electrode holders. A complete set must be provided for each tank or tank section. The wiring between the tank electrodes and the pump unit control panel must be carried out by the contractor to the terminals specified in the pressure unit manufacturer's drawings. Where dual break tanks or compartmentalized tanks are used, a manually operated tank selector must be incorporated into the control wiring to allow isolation of both sets of electrodes from the monitoring system during maintenance procedures.

3.3.12. Data sheets for project pressurization units

3.3.12.1. Non potable pressurization unit

Pressostatic Control Water Pressurization Unit
Composed of 2 or 3 normally aspirated vertical centrifugal pumps with ventilated motors, connected in parallel.
Main characteristics:

- Fully stainless steel centrifugal pumps in high head vertical design of the MVI series with ventilated motor.
- Main pump components approved and suitable for use with potable water.
- Panel with frequency converter for variable speed control of the pumps.
- Switch to pressostatic system in case of inverter malfunction.
- Permitted fluids:
    1. Clean water free of sedimentable substances, cold water, chilled water, rainwater, potable water
- Application fields:
    1. Fluid temperature [°C] 50
    2. Ambient temperature [°C] 40
    3. Max. operating pressure [bar] 16
    4. Max. inlet pressure [bar] 10
- Electrical connections:
    1. Mains supply [V] -
    2. Mains supply [V] 3 ~ 400
    3. Mains frequency [Hz] 50
- Pump motor:
    1. Standard IEC motor
    2. Speed [rpm] 2900
    3. Protection class IP 54
    4. Insulation class F
- Main materials:
    1. Impellers: Stainless steel 1.4301 (AISI 304)
    2. Stage chamber: Stainless steel 1.4301 (AISI 304)
    3. Pump body: 1.4301 (AISI 304) for MVI 2, 4, 8, 16-6 EN-GJL-250 (with KTL layer) for MVI 32
    4. Shaft: Stainless steel 1.4122
    5. Base: Galvanized steel with anti-vibration feet
    6. Manifolds: Stainless steel 1.4301 (AISI 304)
    7. Shut-off valves: Brass CuZn
    8. Check valves: Brass CuZn

Usage
Automatic water supply and pressurization connected directly to the water supply network or a primary collection tank, in residential, commercial, and public buildings, hotels, hospitals, supermarkets, and for industrial and process engineering works. Supply of domestic water, potable water, chilled water, or other water-like liquids that are not chemically or mechanically aggressive to the materials used and do not contain abrasive or fibrous substances.

Construction
Base made of folded and galvanized sheet metal, supported by height-adjustable anti-vibration feet for optimal isolation against system noise propagation.

Manifolds
Models with MVI 400 and 800 series pumps: Made of stainless steel 1.4301 (AISI 304), with a connection for mounting the pressure switch against dry running (suction side) and two connections for mounting membrane hydraulic accumulator tanks and a pressure gauge for reading pressure (discharge side). Models with MVI 16-6 and 32 series pumps: Made of stainless steel 1.4301 (AISI 304), with a connection for mounting the pressure switch against dry running (suction side) and a connection for mounting a membrane hydraulic accumulator tank of adequate capacity and a pressure gauge for reading pressure (discharge side). Pressure switches for emergency operation of the system.

Pumps
2 or 3 vertical multistage pumps of the MVI series, fully made of stainless steel and main components approved by KTW and WRAS.

Valves
On the suction side, ball valves or butterfly valves combined with check valves mounted on each pump. On the discharge side, ball valves or butterfly shut-off valves, one for each pump.

Membrane Hydraulic Accumulator Tank
24-liter version made of painted sheet metal or stainless steel for versions with MVI 200, 400, 800 series pumps. It is recommended to use one tank per pump. Capacity from 80 to 1000 liters depending on the system size for versions with MVI 1600 and 3200 pumps. Interchangeable membrane in bromobutyl.

Control Device
Pre-wired control device, commands, and protections for the correct operation of the entire pumping system. The control device is prepared for the connection of a sensor against dry running of the pumps.

Operation
Automatic operation, one variable speed pump controlled by the frequency converter and the other with direct addition from the network. In case of frequency converter failure, it is possible to switch to pressostatic operation with one pump. The system maintains constant pressure by continuously varying the speed of one pump. When the variable speed pump reaches maximum speed, the system adds the next pump directly from the network. Simple setting of control parameters, with display of hydraulic parameters. Parameter modification is protected by an access code. In case of electronic system failure, the user can operate one of the pumps controlled by the pressure switch (emergency).

Pump Rotation
Standard for all models. At each start, the pumps are automatically reversed to evenly distribute operating hours.

Supply
Pre-assembled and tested pressurization unit, ready for installation, packed, with installation, use, and maintenance instructions.

Dry Running Protection
The control device is prepared for the connection of a sensor against dry running of the pumps, for this purpose a relay with electrodes, a float, or a pressure switch can be used, depending on the type of system implemented (with primary collection tanks at atmospheric pressure or direct connection to the water supply network).

Supply Pressure

Respect the maximum supply pressure (see technical data). The maximum supply pressure is calculated by subtracting the pump head at flow rate Q = 0 from the maximum operating pressure of the system. Respect the maximum supply pressure (see technical data).

GP NPW 01/02

Type: *vertical shaft and variable flow*
Quantity: *2 Unit characteristics*:

- Flow rate: *2.0 l/s*
- Head: *5.0 bar*
- Installed power: *1.1 kW*

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Pressurization unit
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

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1. INTRODUCTION

This specification details the requirements for Package Pressurisation Units for use in projects specified by L22.

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications

2. PERFORMANCE REQUIREMENTS

2.1.1. General

The pressurisation unit shall form a complete package, it shall be capable of both maintaining the design system pressure and of accepting the expansion volume of the system between its normal operating temperature and the initial fill temperature.
The unit shall comprise expansion vessel or vessels, run and standby pumps, break/fill tank and all relays, contactors and controls, interlocks and ancillary equipment necessary to maintain the system operating conditions.
The unit shall be installed in accordance with the manufacturer's instructions and be suitable for the system to which it is to serve, including the chemicals that are to be used within the system.
The integral break tank shall be manufactured from UPVC or GRP and shall be provided with a loose cover and the following fittings:

- Ball valve with type AA or AB air break
- Drain valve
- Overflow warning pipe
- Pump suction pipe with strainer.
- Single pressurization unit with integrated cyclonic vacuum degassing

The unit components shall generally be mounted on a steel base frame with a corrosion resistant powder coated finish.
In noise sensitive locations, the unit shall be located on anti-vibration mountings or an inertia base.
The maximum working pressure of the vessels shall be a minimum of 10 bar unless otherwise stated.

2.1.2. Electricity supply

All equipment shall be suitable for a standard local electrical supply, volt and frequency. Motor requirements are identified in the schedules.

2.1.3. Sizing

The unit shall handle the full expansion volume of the system from normal cold fill, or ambient conditions, to normal working temperature.
A margin of 5% for all water systems without spillage shall also be included.

2.1.4. Expansion vessels

The expansion vessels shall contain a removable butyl rubber sac or diaphragm enclosing a permanent pre-charged air cushion.
Vessels shall be constructed from steel and all parts in contact with water shall be treated against corrosion. External surface shall have a powder coat finished.
Each vessel shall be fitted with a Schrader type valve for filling.
All vessels shall comply with 2014/68/EU Pressure Equipment Directive (PED)
Vessels shall be provided with removable access ports to enable internal inspection and maintenance.
Vessels shall be provided with an information plate, permanently attached giving design information as required by 2014/68/EU Pressure Equipment Directive (PED).

2.1.5. Pumps

The pumps shall be provided with totally enclosed fan cooled motors with class F insulation.
All pumps shall be direct driven.
On sets with motors exceeding 1 kW motor starting shall be by inverter.

2.1.6. Control panel and controls

Control panels shall contain the motor starters, operating and safety controls and all interconnecting wiring.
The panel shall be a minimum of IP54 rated with lockable door and interlocked isolator, visual indication of system pressure and pump status.
The following controls and components shall be provided:

- Pump starters and automatic changeover.
- Pressure switches to control system operation.
- Low and high-pressure alarms.
- Volt free contacts for external status to BMS.
- Visual indication of system pressure.
- Unit fault lamp.
- Inverter control of lead pump where specified.
- Automatic lead pump changeover.
- Hours run metering of pumps.

2.1.7. Connecting pipework and fittings

The pressurisation system shall be provided with the following connections and fittings:

- Mains water fill line with stop valve and water meter
- System fill line with isolating valve and thermal siphon
- Electrical supply with isolator
- System pressure gauge
- Tank overflow taken to suitable drain
- Pressure sensor for remote BMS monitoring
- Quick fill point.

Please note that the Water Byelaws do not permit permanently connected quick fill lines. This must be a disconnected hose, stored nearby, with an isolating valve and hose union on the system and an isolating valve with hose union and an RPZ valve on the mains supply.

2.1.8. High temperature hot water systems

High Temperature Hot Water systems shall generally comply with the clauses in this specification. In this case however, the air expansion vessel(s) shall be replaced by Nitrogen pressure vessels complying with PD 5500 + A3 "Specification for unfired fusion welded pressure vessels".
Manufacturer's guidelines and recommendations must be adhered to.

2.1.9. Spill systems

Spill systems shall have an atmospheric pressure spill tank to accept the expanding water content of the system from its initial temperature (normally 10°C) to its operating temperature.

The entire contents shall be captured by the spill tank to prevent contaminated water overflowing into the drainage system. On loss of pressure the spill tank contents shall automatically re-charge the system back to its operating pressure. System pressure variation shall not exceed 0.6 bar.
The system shall comprise:

- Control panel with pump starters and control components
- Spill tank or vessels
- Expansion vessel(s)
- Interconnecting pipe work
- Automatic operating and safety controls
- Base frame
- Safety valve(s)

Where operating temperatures exceed 90°C, pre-cooling vessels shall be used to cool the water entering the spill tank.
Where spill tanks are used these shall be constructed from galvanised steel and have the following:

- Cover
- Thermal insulation
- Ball valve with type AB air gap
- High and low-level sensors and alarms
- Drain valve
- Overflow and warning pipe
- Spill valve

Arrangements where spill vessels are used shall a break tank and each vessel shall be supplied with a drain valve and an automatic air vent.
All the components of the spill system shall comply with relevant sections of the preceding paragraphs.

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Water treatment
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

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1. INTRODUCTION

This specification details the requirements for Water Treatment.

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications

2. PERFORMANCE REQUIREMENTS

2.1. General filtration

SEMI-AUTOMATIC SELF-CLEANING FILTER

Semi-automatic self-cleaning flanged filters with backwash for high water flow rates. Cyclone operation with helical flow in service. Possibility of timed or deltaP washing. Made of corrosion-resistant red bronze. Complete with ball valve for backwash and motor for activating washing at programmed intervals.

The supply includes: 360° rotatable head, brass union connections with built-in check valve, body in fiberglass-reinforced plastic, stainless steel cartridge with helical system, transparent vessel, semi-automatic drain to activate backwash, and maintenance date indicator. Suitable for both inline and vertical connections.
Includes disassembly/opening key.

TECHNICAL SPECIFICATIONS

- Hourly flow rate: 17 m³/h with delta p 0.2 bar
- In-out connections: 2”
- Dimensions [mm]: Axial dimension 132 – H 360
- Maximum operating pressure: 16 atm
- Maximum water temperature: 65°
- Filtration capacity: 100 microns

Filter Automation, automatic drain with ½” ceramic ball valve and 230V/50 Hz control timer.

TECHNICAL CHARACTERISTICS

- Valve body: PPO
- Valve stem: INOX AISI 316
- Disc: CERAMIC
- Connections: ½”
- Opening/closing time: 3 s
- Voltage: 24 V

2.2. Softening of Domestic Hot Water and System Filling

Office plumbing system with water softener, chemical dosing, and anti-legionella treatment.

Legionellosis

Legionellosis is the collective term used for clinical conditions caused by bacteria from the Legionellaceae family.
Growth of the bacterium is favoured by temperatures between 20°C and 45°C, particularly in the presence of scale or algae.

Legionella bacteria is commonly found to occur in hot water systems, particularly in calorifiers and in cooling water systems serving air conditioning plants.
Stagnant water provides an ideal breeding ground and contamination can occur when deadlegs are present, or when systems are started up after a period of shutdown.
The Table below describes how Legionella reacts to water temperatures:

Range di Temperatura	Effetto della legionella
70 – 80°C	Disinfection range
66°C	Legionella will die in two minutes
60°C	Legionella will die in thirty-two minutes
55°C	Legionella will die in five to six hours
50 to 55°C	Legionella can survive, but do not multiply
20 to 50°C	Legionella growth range
35 to 46°C	Legionella ideal growth range
Below 20°C	Legionella can survive, but are dormant.

Automatic Water Softener

Supply of a water softener for the removal of hardness (Calcium and Magnesium), using selected ion exchange resins suitable for contact with drinking water, strong cationic in sodium cycle, normally regenerable with sea salt.
The vertical cylindrical container is made of corrosion-resistant material, composite material with PE liner coated with fiberglass and epoxy resin, compliant with European Directive 97/23/EC for pressure vessels (PED), TUV certification for contact with drinking water according to EC/KTW directives, and compliant with D.M. no. 174 of 06/04/2004 for materials suitable for contact with water intended for human consumption.
The proportional regeneration technology allows the softener to regenerate only the exhausted part of the resin bed, minimizing the consumption of salt and the related water consumption necessary for regeneration.
The control system allows you to choose the water hardness in service without any additional external mixing device.
The software of the softener monitors daily water usage through a flow meter and offers an advanced diagnostic program.
It allows the regeneration program to be started based on:

- Volume of treated water
- Timed
- Volume of treated water with timed regeneration (domestic volume)

The brine container is made with corrosion-proof components. An automatic bypass system is installed on the valve to provide untreated water to the service even when the softener is regenerating.
The softener is a specific device for the removal of hardness (Calcium and Magnesium), using selected ion exchange resins suitable for contact with drinking water, strong cationic in sodium cycle, normally regenerable with sea salt. The vertical cylindrical container is made of corrosion-resistant material, composite material with PE liner coated with fiberglass and epoxy resin, compliant with European Directive 97/23/EC for pressure vessels (PED), TUV certification for contact with drinking water according to EC/KTW directives, and compliant with D.M. no. 174 of 06/04/2004 for materials suitable for contact with water intended for human consumption.
The system consists of three distinct bodies:

- 2 softeners containing ion exchange resins including an automatic control head for production and regeneration phases;
- 1 polyethylene container for the storage and dissolution of the regenerant, equipped with the necessary accessories.

A dedicated microprocessor allows access to statistical functions that provide important information about the softening system, programming is settable via an electronic keyboard with great flexibility of use.
The softener control unit monitors daily water usage through a flow meter, already installed in the valve body, and offers an advanced diagnostic program. It allows the regeneration program to be started based on:

- Volume of treated water
- Time

- Volume of treated water with timed regeneration

The control unit, monoblock valve, and meter are directly installed on the softener head; for particular needs, the control unit can be wall-mounted and thus separated from the softener body.
The valve, which uses hydraulic pistons, offers more reliability than traditional rotary valves; moreover, the multi-piston valve design allows for easier maintenance and longer durability.
The direct control of the piston valves is carried out through the rotary distributor pilot powered with pre-filtered water (or compressed air) by a special microfilter supplied.

The brine container, made with corrosion-proof components, and the smart brine tank probe that monitors the level and quality of the brine ensure perfect system functionality.

Additionally, the valve is already equipped with an automatic bypass system to provide untreated water to the service even when the softener is regenerating, an overpressure safety valve, and a vacuum breaker valve.

TECHNICAL CHARACTERISTICS for each column

- Resin tank: FRP reinforced fiberglass
- Exchange capacity: min. 907 - max. 1,360 $m^3.^of$
- Salt consumption per regeneration: min. 20 - max. 47.4 kg
- Maximum peak flow rate: 19.3 m^3/h
- Continuous flow rate: 14.8 m^3/h
- Pressure drop at maximum flow rate: 1.7 bar
- Pressure drop at continuous flow rate: 1 bar
- Maximum operating pressure: 8.6 bar
- Minimum pressure for regeneration: 2.4 bar
- Operating temperature min/max: 4°C – 49°C
- Regeneration cycle duration: approximately 100 minutes
- Inlet/outlet connections: 2" threaded
- Resin container diameter and height: 533 x 2,045 mm
- Salt container diameter and height: 762 x 1,270 mm
- Shipping weight: 312 kg
- Operating weight: 1,248 kg
- Power supply: 230/24 V – 50/60 Hz

The mixing and overflow valves automatically mix drinking water in plumbing systems to achieve any desired residual hardness value.
Regardless of the amount of water drawn and pressure fluctuations, the mixer maintains the set residual hardness constant.
Within the same valve, there is an overflow system capable of increasing the flow rate of mixed water in response to any peak flow demands.
The mixer body is made of bronze, and all other components are made of brass, plastic material, and stainless steel.
This device complies with the requirements set out in D.M. 25/12.

TECHNICAL CHARACTERISTICS OF THE MIXING VALVE FOR SYSTEM LOAD SIDE

- Body: bronze
- Head: brass

- Adjustment parts: brass
- Maximum flow rate: 17 m³/h
- Pressure drop: 1 bar at maximum flow rate
- Maximum operating pressure: 10 bar
- Operating temperature range: 90°C
- Dimensions: 130 x 192 mm
- Female threaded connections: 2”

TECHNICAL CHARACTERISTICS OF THE MIXING VALVE FOR HOT WATER PRODUCTION
- Body: bronze
- Head: brass
- Adjustment parts: brass
- Maximum flow rate: 10 m³/h
- Pressure drop: 0.7 bar at maximum flow rate
- Maximum operating pressure: 10 bar
- Operating temperature range: 90°C
- Dimensions: 130 x 102 mm
- Female threaded connections: 1-1/4”

Resin Disinfection System During Regeneration

Supply and installation of an electronic control unit complete with a cell with polarized electrodes, composed as follows:
- Electronic control unit: designed to power a cell (pair of electrodes) with direct current, which, when immersed in the brine, generates chlorine gas through the electrolysis of sodium chloride.
- Cell with electrodes: made of plastic material; inside it are two electrodes: one in platinum-coated titanium and one in stainless steel. On the body of the cell, there is a connector for connecting the power supply/electronic control unit.

2.3. Protective Dosing for Hot Water filling in

Impulse Turbine Meter

Single or multi-jet dry dial turbine meter for measuring potable water consumption through direct reading on numbered rollers. The meter is designed to signal to any external instrument the dosing frequency based on the detected flow rate, thanks to the pulse sensor positioned on the dial.

TECHNICAL CHARACTERISTICS
- Magnetic pulse transmission with anti-fraud protection.
- Reed contact: 24VDC - 50mA - 100Ω.
- Ratio R = 80 (ratio between minimum flow rate and nominal flow rate).
- Liter totalizer in a dry and vacuum environment for better visibility and durability.
- Metric seal.
- Pulse/liter value modifiable if water consumption measurement is not for fiscal purposes.
- Brass body painted with epoxy resin.
- Production hydraulically verified and approved by a third party.

- Compliance with 2014/32/EU (MID Directive).
- Compliance with ISO 4064 (Water meters - technical and metrological requirements).
- ACS sanitary certification (Attestation de Conformité Sanitaire).
- DM174 certification (Materials in contact with drinking water).

System for Dosing Corrosion Inhibitor and Accessories

System for dosing a corrosion inhibitor, complete with:

- Dosing pump with special membrane resistant to chlorine, chlorine dioxide, PVDF pump body with self-venting discharge valve, inlet for flow control sensor. Integrated alarm relay on the pump to remotely signal operating anomalies.
- Bottom filter
- Suction and discharge tubing
- Adapter for self-venting pump body with connection for flow sensor (only for chlorine dioxide dosing pump)
- PVDF dosing valve (springless version) only for dosing pump
- Minimum level kit
- Support kit for dosing pump

HOT WATER PRODUCTION AND ANTI-LEGIONELLA DISINFECTION SYSTEM

TECHNICAL DATA:

- Frequency: programmable from 0 to 140 pulses/minute
- Max. flow rate: 2 l/h
- Max. pressure: 18 bar
- Suction height: max. 1.5 m
- Suction/discharge tubes: 4x6 mm
- Dosing accuracy: +5%; -10%
- Power supply: 230 V~, 50/60 Hz, -30…+10%, 55 VA max. (standard version: cable with Schuko plug)
- Power: max. 55 W
- Protection: 4x20 F1.6A fuse
- Clock: real-time, accuracy ±5 sec/month, with CR2032 backup battery (minimum autonomy of 3 years without power)

OPERATING CONDITIONS:

- Storage temperature: from -20 to +60°C
- Operating temperature: from -10 to +45°C
- Relative humidity: max. 90% without condensation
- Protection rating: IP65
- Dimensions / Weight: 110 x 260 x 190 mm
- Weight: 3 kg
- Installation: base-mounted

MATERIALS:

- Case: PP reinforced with fiberglass
- Head: PVDF
- Membrane: high-quality EPDM with fabric reinforcement, steel core, and PTFE coating on the fluid contact side
- Seals: PTFE for PVDF heads
- Valves: ceramic ball
- Suction tube: PVC Crystal
- Discharge tube: PE

ANALOG INPUTS:

- Analog input: 0-20 or 4-20 mA (programmable)

Input impedance 30Ω; accuracy > ± 0.05 mA, repeatability > ± 0.03 mA

DIGITAL INPUTS:

- General technical data: open-circuit voltage: typical 10 V, max. 18 V
  Closed contact current: max. 3.8 mA
  Power supply voltage for micro-magnetics: 18 V ±5%, max. 10 mA
  Frequency: max. 10 Hz (minimum pulse duration 50 msec)
- Enable input: potential-free contact or NPN micro-magnetic (in the case of flow cell)
- Level/flow input: potential-free contact, from level or flow sensor
- Pulse input: clean contact, 5V/5mA; max. frequency 300 pulses/min.

OUTPUTS:

- Alarm relay: NO / NC contact, programmable, max. 30V~ (40V-), 3A resistive

ACCESSORIES:
Included in the supply:

- Bottom filter
- Suction tube
- Discharge tube
- Injection valve
- Minimum level kit
- Support kit for dosing pump

Support Kit for Dosing Pump
The support platform to which the pump base is fixed can rotate 360° to allow easy access to both the button and display panel and the head and connections (thus facilitating maintenance operations).

Chemical Container with Corrosion Inhibitor

- Shape: vertical cylindrical
- Pressure: atmospheric

- Accessories: flat screw cap for dosing pump
- Material: PE

Corrosion Inhibitor for System Load
Food-grade liquid corrosion inhibitor for the preventive protection of water supply networks, industrial systems, and hot and cold sanitary water systems of any type, made of galvanized steel, copper, brass, and synthetic materials, in which aggressive water circulates; composed of a guaranteed food-grade purity synergistic mixture of natural silicate-based corrosion inhibitors and pH correctors. Not to be used in water with hardness greater than 15°f.

2.4. Biocide Dosing for Legionella Prevention in Hot Water Systems

3-Channel Splitter for Anti-Legionella Dosing Pumps
The signal splitter panel is used to duplicate the impulse from a meter and simultaneously control up to 3 dosing pumps.

System for Dosing Anti-Legionella Biocide and Accessories
System for dosing a biocide product, complete with:
- Dosing pump with special membrane resistant to chlorine, chlorine dioxide, PVDF pump body with self-venting discharge valve, inlet for flow control sensor. Integrated alarm relay on the pump to remotely signal operating anomalies.
- Bottom filter
- Suction and discharge tubing
- Adapter for self-venting pump body with connection for flow sensor (only for chlorine dioxide dosing pump)
- PVDF dosing valve (springless version) only for dosing pump
- Minimum level kit
- Flow sensor (to be ordered separately)
- Support kit for dosing pump (to be ordered separately)
- Removable and cleanable injection lance (to be ordered separately)

TECHNICAL DATA:
- Frequency: programmable from 0 to 140 pulses/minute
- Max. flow rate: 2 l/h
- Max. pressure: 18 bar
- Suction height: max. 1.5 m
- Suction/discharge tubes: 4x6 mm
- Dosing accuracy: +5%; -10%
- Power supply: 230 V~, 50/60 Hz, -30…+10%, 55 VA max. (standard version: cable with Schuko plug)
- Power: max. 55 W
- Protection: 4x20 F1.6A fuse
- Clock: real-time, accuracy ±5 sec/month, with CR2032 backup battery (minimum autonomy of 3 years without power)

OPERATING CONDITIONS:
- Storage temperature: from -20 to +60°C

- Operating temperature: from -10 to +45°C
- Relative humidity: max. 90% without condensation
- Protection rating: IP65
- Dimensions / Weight: 110 x 260 x 190 mm
- Weight: 3 kg
- Installation: base-mounted

MATERIALS:
- Case: PP reinforced with fiberglass
- Head: PVDF
- Membrane: high-quality EPDM with fabric reinforcement, steel core, and PTFE coating on the fluid contact side
- Seals: PTFE for PVDF heads
- Valves: ceramic ball
- Suction tube: PVC Crystal
- Discharge tube: PE

ANALOG INPUTS:
- Analog input: 0-20 or 4-20 mA (programmable)

  Input impedance 30Ω; accuracy > ± 0.05 mA, repeatability > ± 0.03 mA

DIGITAL INPUTS:
- General technical data: open-circuit voltage: typical 10 V, max. 18 V

  Closed contact current: max. 3.8 mA

  Power supply voltage for micro-magnetics: 18 V ±5%, max. 10 mA

  Frequency: max. 10 Hz (minimum pulse duration 50 msec)
- Enable input: potential-free contact or NPN micro-magnetic (in the case of flow cell)
- Level/flow input: potential-free contact, from level or flow sensor
- Flow sensor input: contact from injection flow control sensor
- Pulse input: clean contact, 5V/5mA; max. frequency 300 pulses/min.

OUTPUTS:
- Alarm relay: NO / NC contact, programmable, max. 30V~ (40V-), 3A resistive

ACCESSORIES:
Included in the supply:
- Bottom filter
- Suction tube
- Discharge tube
- Injection valve

- Minimum level kit
- Support kit
- Removable injection lance kit

Flow Sensor for Dosing Pump Monitoring

Supply and installation of a flow sensor for monitoring the passage of liquid dosed by a dosing pump. It is mounted directly on the discharge side of standard heads.

Operating Conditions:

- Temperature: 1 … 55 °C
- Pressure: 0.5 … 25 bar
- Dosed liquid density: max. 1.25 g/cm³
- Minimum stroke for standard heads: 50%
- Minimum stroke for heads with self-venting option: 60%

The actual flow rate can be calculated using the following formulas, although it is advisable to determine it in the field, with the pump in real working conditions:

- Standard heads: Qe = Qn x %stroke
- Heads with self-venting: Qe = Qn x %stroke x 0.85

Support Kit for Dosing Pump

The support platform to which the pump base is fixed can rotate 360° to allow easy access to both the button and display panel and the head and connections (thus facilitating maintenance operations).

Chemical Container for Biocide

- Shape: vertical cylindrical
- Pressure: atmospheric
- Accessories: flat screw cap for dosing pump, flat platform for dosing pump
- Material: PE

BELOX 35 F Biocide PT5 is an ECHA-authorized biocide product for Product Types 2-3-4-5. Additionally, the product is registered with the Ministry of Health for sale in the national territory. It effectively disinfects against germs and bacteria and is highly effective against numerous pathogens such as Legionella, Salmonella, Pseudomonas, and fungi. It leaves no insoluble residue.

The product complies with the requirements of Art.11 of Legislative Decree 18/2023 "Minimum requirements for chemical reagents and active and passive filtering materials to be used in the treatment of water intended for human consumption."

2.5. Conditioning of Closed Technological Circuits

Impulse Turbine Meter

Single or multi-jet dry dial turbine meter for measuring potable water consumption through direct reading on numbered rollers. The meter is designed to signal to any external instrument the dosing frequency based on the detected flow rate, thanks to the pulse sensor positioned on the dial.

TECHNICAL CHARACTERISTICS

- Magnetic pulse transmission with anti-fraud protection.
- Reed contact: 24VDC - 50mA - 100Ω.
- Ratio R = 80 (ratio between minimum flow rate and nominal flow rate).

- Liter totalizer in a dry and vacuum environment for better visibility and durability.
- Metric seal.
- Pulse/liter value modifiable if water consumption measurement is not for fiscal purposes.
- Brass body painted with epoxy resin.
- Production hydraulically verified and approved by a third party.
- Compliance with 2014/32/EU (MID Directive).
- Compliance with ISO 4064 (Water meters - technical and metrological requirements).
- ACS sanitary certification (Attestation de Conformité Sanitaire).
- DM174 certification (Materials in contact with drinking water).

Dosing Pump

System for dosing a corrosion inhibitor, complete with:

- Dosing pump with special membrane resistant to chlorine, chlorine dioxide, PVDF pump body with self-venting discharge valve, inlet for flow control sensor. Integrated alarm relay on the pump to remotely signal operating anomalies.
- Bottom filter
- Suction and discharge tubing
- Adapter for self-venting pump body with connection for flow sensor (only for chlorine dioxide dosing pump)
- PVDF dosing valve (springless version) only for dosing pump
- Minimum level kit
- Support kit for dosing pump (to be ordered separately)

SYSTEM LOAD FOR TECHNOLOGICAL CIRCUITS

TECHNICAL DATA:

- Frequency: programmable from 0 to 140 pulses/minute
- Max. flow rate: 11 l/h
- Max. pressure: 2 bar
- Suction height: max. 1.5 m
- Suction/discharge tubes: 5x8 mm
- Dosing accuracy: +5%; -10%
- Power supply: 230 V~, 50/60 Hz, -30…+10%, 55 VA max. (standard version: cable with Schuko plug)
- Power: max. 55 W
- Protection: 4x20 F1.6A fuse
- Clock: real-time, accuracy ±5 sec/month, with CR2032 backup battery (minimum autonomy of 3 years without power)

OPERATING CONDITIONS:

- Storage temperature: from -20 to +60°C
- Operating temperature: from -10 to +45°C
- Relative humidity: max. 90% without condensation

- Protection rating: IP65
- Dimensions / Weight: 110 x 260 x 190 mm
- Weight: 3 kg
- Installation: base-mounted

MATERIALS:
- Case: PP reinforced with fiberglass
- Head: PVDF
- Membrane: high-quality EPDM with fabric reinforcement, steel core, and PTFE coating on the fluid contact side
- Seals: PTFE for PVDF heads
- Valves: ceramic ball
- Suction tube: PVC Crystal
- Discharge tube: PE

ANALOG INPUTS:
- Analog input: 0-20 or 4-20 mA (programmable)
  Input impedance 30Ω; accuracy > ± 0.05 mA, repeatability > ± 0.03 mA

DIGITAL INPUTS:
- General technical data: open-circuit voltage: typical 10 V, max. 18 V
  Closed contact current: max. 3.8 mA
  Power supply voltage for micro-magnetics: 18 V ±5%, max. 10 mA
  Frequency: max. 10 Hz (minimum pulse duration 50 msec)
- Enable input: potential-free contact or NPN micro-magnetic (in the case of flow cell)
- Level/flow input: potential-free contact, from level or flow sensor
- Pulse input: clean contact, 5V/5mA; max. frequency 300 pulses/min.

OUTPUTS:
- Alarm relay: NO / NC contact, programmable, max. 30V~ (40V-), 3A resistive

Chemical Container for Biocide
- Shape: vertical cylindrical
- Pressure: atmospheric
- Accessories: flat screw cap for dosing pump, flat platform for dosing pump
- Material: PE

Corrosion/Scale Inhibitor and Biocide for Closed Multimetal Circuits, Including Aluminum
Compatible with antifreeze. Does not contain molybdates.

2.6. Automatic Filtration for Closed Circuits (High Temperature Version)

Primary Circuit Filtration Column

Column filter for the removal of iron oxides, sludge, and scale.

Each filter essentially consists of:

- Filter body with filtering media
- Insulation of the filter body
- Group of automatic diaphragm valves
- Air release valve
- Chemical loading valve
- Control unit for complete filter management

The operating principle is based on water filtration, where the water passes through appropriate media with controlled granulometry, retaining suspended impurities and exiting clarified.
At the end of the production cycle, predetermined based on the quality of the water to be filtered, the device will automatically perform the washing phase, usually using the same raw feed water under the subsequently indicated operating conditions.
The system operation is managed by an electronic microprocessor programmer with a programming keyboard for all service-regeneration operations and a luminous display to indicate the current operating status, while the direct control of the diaphragm valves is carried out through a water-powered distribution system. Both the electronic programmer and the pilot are housed in their own enclosure, with a transparent front, and installed directly on the filter.

TECHNICAL CHARACTERISTICS

- Design flow rate: 2.5 m³/h
- Pressure drop (start – end of cycle): approximately 0.4 – 0.8 bar
- Operating pressure: max. 4 bar
- Flow rate required for backwashing: 3 m³/h
- Ambient temperature: 5 – 50 °C
- Water temperature: max 75°C
- Inlet/outlet and drain connections: 1-1/2”
- Container diameter: 700 mm
- Container height: 1,010 mm
- Dimensions: 850 x 700 x 1010 mm (h)

2.7. Filtration of Rainwater Reuse Circuit

Rainwater Filtration

Each filter consists of:

- 1 reinforced polyester container in blue color with dimensions: diameter 770 mm, total height 1025 mm.
- 1 manual 6-way multiport valve for filtration, backwashing, rinsing, recirculation, draining, and closed valve operations.
- 2 pressure gauges for monitoring the pressure at the filter inlet and outlet.
- 1 top cover.
- 1 lower and upper PVC diffuser for uniform water distribution inside the filter.
- 1 mineral kit divided into underbed (1 layer) and filter bed (3 layers).

TECHNICAL CHARACTERISTICS

- Design flow rate: 20 m³/h
- Backwash flow rate: 16 m³/h
- Pressure drop (start – end of cycle): approximately 0.25 – 0.75 bar
- Operating pressure: min. 1.0 - max. 2.5 bar
- Temperature: min. 5 - max. 50°C

2.8. Disinfection of Rainwater Recovery Circuit

Chlorine Indicator Analyzer

Digital microprocessor devices designed for wall mounting. All models are equipped with a configurable output, output relay as an intervention point for dosing system regulation or alarms, a fully programmable and galvanically isolated current output, a serial output for communication with a PC (optional software). Alarms and errors are displayed directly on the screen, and programming and calibration data are stored in non-volatile memory for at least 10 years.
The version in question consists of:

- 1 control unit
- 1 potentiostatic cell
- 1 flow-through probe holder
- 1 PT100 temperature probe
- 1 safety filter
- 1 pre-assembled panel

TECHNICAL CHARACTERISTICS OF THE CONTROL UNIT

Power Supply	: 230 Vac ±10%, 50/60 Hz (115 Vac, 24 Vac, or 24 Vdc on request); protected by an internal self-resetting fuse (PTC)
Power Consumption	: max 7 VA
Protection	: self-resetting PTC fuse
Operating Conditions:	Storage temperature: -20 to +60°C Operating temperature: -10 to +50°C Relative humidity: max. 90% without condensation
Display	: two-line alphanumeric LCD display, backlit
Protection Rating	: IP66
Dimensions	: 240 x 300 x h 125 mm
Weight	: approximately 1.5 kg
Installation	: wall-mounted
External Case Material	: ABS
Digital Inputs	: 1 OFF/FLOW input to disable outputs; accepts a potential-free contact (voltage at terminals 5 V, max current 5 mA)
Analog Inputs	: accuracy better than 0.3% of F.S. – repeatability better than 0.2% of F.S.
Temperature Input	: Pt100 temperature sensor
Relay Outputs	: 2 independent, max capacity 250 V / 3 A resistive
Current Outputs	: 1 output 0-20 mA or 4-20 mA, galvanically isolated
Serial Outputs	: 1 standard 4-pin RS232 output

TECHNICAL CHARACTERISTICS OF THE FILTER

Filter Body Material	: polycarbonate/PE

Filter Cartridge Material : wound polypropylene
Filtration Grade : 10 µm

TECHNICAL CHARACTERISTICS OF THE ANALYSIS CELL
Measurement Principle : potentiostatic cell with two electrodes and ion-selective membrane
Temperature Compensation : automatic within the range 0 … 45°C
Maximum Temperature : 45°C
Measurement Range : 0.005 … 2.000 ppm Cl2
Maximum Pressure : 1 bar
Operating Flow Rate : 40 l/h
Process Connections : hose connector with 13 mm outer diameter
Flow Cell : transparent plexiglass
Provision : housings for flow sensor and pH electrode
Dimensions : approximately 210 x 190 x 50 mm

Electromagnetic Dosing Pump

Professional multifunction digital pumps equipped with a powerful microprocessor, which allows:

- Acquisition and management of analog measurements with high resolution
- Pulse and analog input
- Easy calibration and programming operations, with data saved in non-volatile memory for at least 10 years
- Display of alarms and errors (diagnostics) on the screen
- Control of an internal clock (powered by a backup battery) for setting daily or weekly on/off times
- Control of level (or flow) inputs, enable, overtemperature
- Display of data on a 2-line x 12-character alphanumeric LCD, backlit
- Control of the pump magnet in ON/OFF or proportional mode, with compensation for variations in supply voltage
- Auto-priming function
- Multilingual interface
- Supports ON/OFF, proportional, 4-20 mA, ppm, timed, and pause-work operation modes.

TECHNICAL DATA:
Frequency : programmable from 0 to 140 pulses/minute
Max Flow Rate : 2 l/h
Max Pressure : 18 bar
Suction Height : max. 1.5 m
Suction/Discharge Tubes : 4x6 mm
Dosing Accuracy : +5%; -10%
Power Supply : 230 V~, 50/60 Hz, -30…+10%, max. 55 VA (standard version: cable with Schuko plug)
Power Consumption : max. 55 W
Protection : 4x20 F1.6A fuse
Clock : real-time, accuracy ±5 sec/month,
with CR2032 backup battery (minimum autonomy of 3 years without power)
OPERATING CONDITIONS
Storage temperature : -20 to +60°C
Operating temperature : -10 to +45°C
Relative humidity : max. 90% without condensation
Protection Rating : IP65

Dimensions / Weight	: 110 x 260 x 190 mm
Weight	: 3 kg
Installation	: base-mounted
MATERIALS:	
Case	: PP reinforced with fiberglass
Head	: PVDF
Membrane	: high-quality EPDM with fabric reinforcement, steel core, and PTFE coating on the fluid contact side
Seals	: PTFE for PVDF heads
Valves	: ceramic ball
Suction Tube	: PVC Crystal
Discharge Tube	: PE
ANALOG INPUTS	
Analog Input	: 0-20 or 4-20 mA (programmable) Input impedance 30Ω; accuracy > ± 0.05 mA, repeatability > ± 0.03 mA
DIGITAL INPUTS	
General Technical Data:	Open-circuit voltage: typical 10 V, max. 18 V Closed-contact current: max. 3.8 mA Supply voltage for micro-magnetics: 18 V ±5%, max. 10 mA Frequency: max. 10 Hz (minimum pulse duration 50 msec)
Enable Input	: potential-free contact or NPN micro magnetic (in the case of flow cell)
Level/Flow Input	: potential-free contact, from level or flow sensor
Pulse Input	: clean contact, 5V/5mA; max. frequency 300 pulses/min.
OUTPUTS	
Alarm Relay	: NO / NC contact, programmable, max. 30V~ (40V-), 3A resistive

ACCESSORIES
The supply includes:

- Foot filter
- Suction tube
- Discharge tube
- Injection valve
- Minimum level kit

Support Kit for Dosing Pump

The support platform to which the pump base is fixed can rotate 360° to allow easy access to both the button and display panel and the head and connections (thus facilitating maintenance operations).

Biocide Chemical Container

Chemical container with safety tank.
Shape: vertical cylinder
Diameter: 510 mm
Overall Height: 755 mm
Usable Capacity: 100 liters
Pressure: atmospheric
Construction Material: PE

Accessories: Screw cap, rigid platform for dosing pump
Sodium Hypochlorite Solution 15% for Use in Drinking and Pool Water
Dosage:

- For Drinking Water: 0.4 - 0.6 ppm
- For Pool Water: 2 - 3 ppm

2.9. UV Antibacterial Treatment

UV Sterilizer

Technical Characteristics

Max Flow Rate	: 24 m³/h
UVC Transmittance	: 98% - 1 cm
UVC Dose	: 400 J/m²
Water Temperature	: 5-50°C
Total Power Consumption	: 222 W
Installation	: Horizontal or vertical

COLLECTOR

Material	: Stainless steel 316L
IN-OUT Connections	: 2M threaded
Drain/Sample Port	: 1/8" ½" M threaded
Total Volume	: 21.5 l
Total Weight	: 13 kg
Working Pressure (max.)	: 10 bars g
Protection Rating	: IP 65
Geometry	: L
Cleaning System	: Optional

Quartz Cleaning System Manual or Automatic: NO

UV Lamp

Number	: 1
Lamp Life	: 14,000 hr
Lamp Power	: 200 W each
Type	: BP amalgam lamp

UV Sensor

Type	: Selective UVC sensor
Sensor Cable	: 4-meter shielded cable
Sensor Support Material	: Teflon
Electrical Panel	: Rack LCD
Material and Color	: Painted steel – RAL 7035
Dimensions	: 400 x 300 x 200 mm
Protection Rating	: IP 54
Ambient Temperature	: 5 – 45°C
Relative Humidity	: 20-95% without condensation
Power Supply	: 230 V - 50/60 Hz
Lamp Cables	: 2.5 m
Power Cable	: 1 m

Monitor Display	: LCD
Counter	: Yes, for the total system life
Resettable Counter	: Yes, for lamp life control
Lamp Operation Control	: Yes
Alarm LED	: Yes
Clean Contact (NO - NC)	: Yes – general alarm (max 2 A)
230 V Output (NO - NC)	: Yes – general alarm (max 2 A)
Remote ON/OFF	: Yes (configurable)
ON/OFF Timer	: Yes (configurable)

Reactor Temperature Measurement and Alarm:	Yes (°C) – Configurable threshold value (shutdown for high temperature)
Irradiation Measurement and Alarm:	Yes (% or W/m² optional) – Configurable threshold value 4/20 mA Output: Irradiation and temperature

Audio Alarm: Optional

2.10. Chlorine Neutralizer for Irrigation

Threaded Pulse Emitter Meter

Single or multiple jet dry dial turbine meter for detecting potable water consumption for residential or industrial use through direct reading on numbered rollers. The meter is designed to signal any external instrument the dosing frequency based on the detected flow rate, thanks to the pulse emitter sensor positioned on the dial.

TECHNICAL SPECIFICATIONS OF THE METER

Diameter	: 40 mm – 1.5”
Minimum Flow Rate	: 200 L/h
Nominal Flow Rate	: 16 m³/h
Maximum Flow Rate	: 20 m³/h
Pressure Drop at Qmax	: < 0.63 bar
Max Operating Pressure	: 16 bar
Max Operating Temperature	: 30°C
Weight	: 5.4 kg
Length	: 300 mm

TECHNICAL CHARACTERISTICS
Magnetic pulse transmission with anti-fraud protection.
Reed contact: 24VDC - 50mA - 100Ω.
Ratio R = 80 (ratio between minimum and nominal flow rate).
Dry and vacuum-sealed totalizer for better visibility and durability.
Metric seal.
Pulse value per liter can be modified if water consumption detection is not for fiscal purposes.
Epoxy resin painted brass body.
Hydraulically verified production and approved by a third party.
Compliance with 2014/32/EU (MID Directive).
Compliance with ISO 4064 (Water meters - technical and metrological requirements).
ACS (Attestation de Conformité Sanitaire) certification.
DM174 certification (Materials in contact with drinking water).

Electromagnetic Dosing Pump

The dosing pumps are professional multifunction digital pumps equipped with a powerful microprocessor, which allows:

- Acquisition and management of analog measurements with high resolution
- Pulse and analog input
- Easy calibration and programming operations, with data saved in non-volatile memory for at least 10 years
- Display of alarms and errors (diagnostics) on the screen
- Control of an internal clock (powered by a backup battery) for setting daily or weekly on/off times
- Control of level (or flow) inputs, enable, overtemperature
- Display of data on a 2-line x 12-character alphanumeric LCD, backlit
- Control of the pump magnet in ON/OFF or proportional mode, with compensation for variations in supply voltage
- Auto-priming function
- Multilingual interface

Supports ON/OFF, proportional, 4-20 mA, ppm, timed, and pause-work operation modes.

TECHNICAL DATA:

Frequency	: programmable from 0 to 140 pulses/minute
Max Flow Rate	: 2 l/h
Max Pressure	: 18 bar
Suction Height	: max. 1.5 m
Suction/Discharge Tubes	: 4x6 mm
Dosing Accuracy	: +5%; -10%
Power Supply	: 230 V~, 50/60 Hz, -30…+10%, max. 55 VA (standard version: cable with Schuko plug)
Power Consumption	: max. 55 W
Protection	: 4x20 F1.6A fuse
Clock	: real-time, accuracy ±5 sec/month, with CR2032 backup battery (minimum autonomy of 3 years without power)

OPERATING CONDITIONS

Storage temperature	: -20 to +60°C
Operating temperature	: -10 to +45°C
Relative humidity	: max. 90% without condensation
Protection Rating	: IP65
Dimensions / Weight	: 110 x 260 x 190 mm
Weight	: 3 kg
Installation	: base-mounted

MATERIALS:

Case	: PP reinforced with fiberglass
Head	: PVDF
Membrane	: high-quality EPDM with fabric reinforcement, steel core, and PTFE coating on the fluid contact side
Seals	: PTFE for PVDF heads
Valves	: ceramic ball
Suction Tube	: PVC Crystal
Discharge Tube	: PE

ANALOG INPUTS

Analog Input: 0-20 or 4-20 mA (programmable)
Input impedance 30Ω; accuracy > ± 0.05 mA, repeatability > ± 0.03 mA

DIGITAL INPUTS

General Technical Data:	Open-circuit voltage: typical 10 V, max. 18 V
Closed-contact current:	max. 3.8 mA
Supply voltage for micro-magnetics:	18 V ±5%, max. 10 mA
Frequency:	max. 10 Hz (minimum pulse duration 50 msec)
Enable Input:	potential-free contact or NPN micro magnetic (in the case of flow cell)
Level/Flow Input:	potential-free contact, from level or flow sensor
Pulse Input:	clean contact, 5V/5mA; max. frequency 300 pulses/min.

OUTPUTS

Alarm Relay:	NO / NC contact, programmable, max. 30V~ (40V-), 3A resistive

ACCESSORIES
The supply includes:

- Foot filter
- Suction tube
- Discharge tube
- Injection valve
- Minimum level kit

Support Kit for Dosing Pump
The support platform to which the pump base is fixed can rotate 360° to allow easy access to both the button and display panel and the head and connections (thus facilitating maintenance operations).

Removable Injection Lance Kit
It is particularly useful in situations where the injector tends to clog due to the characteristics of the injected chemical product or water. Thanks to the ball valve, it is possible to hydraulically isolate the injection lance and perform maintenance without any problems. Additionally, the 28 cm long injection system allows it to reach perfectly into the center of the pipe, improving the mixing of water and chemical product.

Chemical Container

Shape:	vertical cylinder
Diameter:	460 mm
Overall Height:	640 mm
Usable Capacity:	100 liters
Pressure:	atmospheric
Construction Material:	PE
Accessories:	Screw cap, rigid platform for dosing pump

Liquid Product for Chlorine Neutralization

Static Mixer Stainless Steel AISI 316L DN 50

Static mixer used to promote intimate mixing between water and the conditioning chemical product. The mixer consists of a containment body in AISI 316L stainless steel, containing mixing elements of the same material, arranged in a "honeycomb" pattern to achieve maximum mixing while minimizing possible pressure losses.

TECHNICAL CHARACTERISTICS

Body:	AISI 316L stainless steel
Plates:	AISI 316L stainless steel
Loose Flanges:	Aluminum UNI 6089/DIN 2642 PN 10
Mixing Elements:	AISI 316L stainless steel
Inlet/Outlet:	DN 50
Side Connections:	½" GAS F
Length:	350 mm
Weight:	4 Kg

Analyzer-Indicator

These are digital microprocessor devices designed for wall mounting. All models are equipped with two configurable output relays as intervention points for dosing system regulation or alarms, a fully programmable and galvanically isolated current output, and a serial output for communication with a PC (optional software). Alarms and errors are displayed directly on the screen, and programming and calibration data are stored in non-volatile memory for at least 10 years.

The version in question consists of:
1 control unit
1 pH cell
1 flow-through probe holder
1 pre-assembled panel

TECHNICAL CHARACTERISTICS OF THE CONTROL UNIT

Power Supply:	230 Vac ±10%, 50/60 Hz (115 Vac, 24 Vac, or 24 Vdc on request); protected by an internal self-resetting fuse (PTC)
Power Consumption:	max 7 VA
Protection:	self-resetting PTC fuse

Operating Conditions:

Storage temperature:	-20 to +60°C
Operating temperature:	-10 to +50°C
Relative humidity:	max. 90% without condensation
Display:	two-line alphanumeric LCD display, backlit
Protection Rating:	IP66
Dimensions:	240 x 300 x h 125 mm
Weight:	approximately 1.5 kg
Installation:	wall-mounted
External Case Material:	ABS
Digital Inputs:	1 OFF/FLOW input to disable outputs; accepts a potential-free contact (voltage at terminals 5 V, max current 5 mA)
Analog Inputs:	accuracy better than 0.3% of F.S. – repeatability better than 0.2% of F.S.
Temperature Input:	Pt100 temperature sensor
Relay Outputs:	2 independent, max capacity 250 V / 3 A resistive
Current Outputs:	1 output 0-20 mA or 4-20 mA, galvanically isolated
Serial Outputs:	1 standard 4-pin RS232 output

TECHNICAL CHARACTERISTICS OF THE ELECTRODE

Combined pH electrode with glass body, porous ceramic junction, gel electrolyte, threaded head.

Scale:	0 to 14 pH; Offset: ±20 mV at pH 7
Max Temperature:	80°C
Max Working Pressure:	2 bar at ambient temperature

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Containment tanks
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

Document: A18 ES E CM 01-

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1. INTRODUCTION

This specification details the requirements for containment tanks.

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications.

2. TECHNICAL FEATURES

All tanks must be internally waterproofed.

2.1. Emergency Shutoff Valves for Accidental Diesel/Urea/Glycol Spills

Ball valve, suitable for use with hydrocarbons, glycol, natural gas, air, oils, and greases.
The valves are equipped with an electric actuator (220VAC), with limit switches for opening/closing (status).
In case of electric motor actuator failure, the valve remains in position (no automatic spring return) and a manual release mechanism must be present on the electric motor actuator.
The valves must be equipped with a Viton elastomer seal, a fluorinated elastomer that offers excellent chemical and thermal resistance, suitable for applications with hydrocarbons.

Technical Characteristics:
- Body: ductile cast iron
- Sleeve: sealing
- Flange: PN10
- Operating temperature: -20°C ÷ +60°C

2.2. Glycol containment tank

Prefabricated monobloc tank in reinforced concrete made with self-compacting concrete (SCC), prepared with PORTLAND CEMENT compliant with UNI EN 197-1, with the addition of type I minerals – ventilated calcium carbonate filler and aggregates compliant with UNI EN 12620, with a compressive strength of C50/60 (Rck ≥ 600 Kg./cm²), exposure classes XC4 (resistant to carbonation-induced corrosion), XS2/XD2 (resistant to chloride-induced corrosion), XF1 (resistant to freeze/thaw attack) compliant with UNI EN 206-1, equipped with internal steel reinforcements with improved adhesion and B450C welded mesh controlled in the factory, all compliant with D.M. 17.01.2018, with external and internal surfaces finished to eliminate porosity and gravel nests.

Included:
- Butyl rubber sealing gasket between the tank and the cover slab
- Internal epoxy coating with the following characteristics:
    1. Double layer of epoxy paint
    2. Dry film thickness: not less than 80 microns
    3. Adhesion: not less than 2 N/mm² according to ISO 4624
    4. Impact resistance: at least 4 Nm, according to ISO 6272
    5. Scratch resistance: at least 50 N, according to ISO 1518
    6. Porosity: the coating is pore-free

The described stratigraphy has the following performance characteristics:

- COLD FLEXIBILITY: -20°C

Dimension to be included in the data sheet:
Type: C-____
External tank dimensions: cm ____ x ____ x (h=___)
Internal geometric capacity: ____ m³
Weight: ql ____

- Drive-over cover for heavy traffic (1st category road loads) prefabricated monoblock in reinforced concrete made with self-compacting concrete (SCC), prepared with PORTLAND CEMENT compliant with UNI EN 197-1, with the addition of type I minerals – ventilated calcium carbonate filler and aggregates compliant with UNI EN 12620, with a compressive strength of C50/60 (Rck ≥ 600 Kg./cm²), exposure classes XC4 (resistant to carbonation-induced corrosion), XS2/XD2 (resistant to chloride-induced corrosion), XF1 (resistant to freeze/thaw attack) compliant with UNI EN 206-1, equipped with internal steel reinforcements with improved adhesion and B450C welded mesh controlled in the factory, all compliant with D.M. 17.01.2018, with external and internal surfaces finished to eliminate porosity and gravel nests. – complete with no. 1 D400 ductile iron manhole cover, light cm 60×60

External cover dimensions: cm ___ x ____ x (thickness=20) Weight: ql _____

The installation of the tanks must be carried out according to the technical data sheet.

2.3. Accidental Diesel and/or Urea Spill Containment Tank

Supply of a single-piece, perfectly watertight, prefabricated reinforced concrete tank, manufactured with concrete RcK > 500 kg/cm², vibrated on metal forms and adequately cured, with complete elimination of surface porosity and "honeycombs", with internal steel reinforcement with improved bond and welded square and rectangular mesh of type FeB 44K, controlled in the factory, all in compliance with NTC 2018, complete with a drive-over cover (1st category loads).

Including openings on the cover for inspection and maintenance to be protected with cast iron manholes included in the price, to be installed on site.

SINGLE-PIECE REINFORCED CONCRETE TANK model PVR750 – geometric void mc 38.2 – minimum useful volume *30 mc*

External dimensions:
Length: *cm 780 (int. 750)*
Width: *cm 250 (int. 223)*
Height: *cm 245 + cm 20 drive-over cover*
Weight: *approx. 218 q.l. + 90 q.l. for the cover*

HOLES LOCATION AS PER PROJECT

Included:
- Butyl rubber sealing gasket between the tank and the cover slab
- Internal epoxy coating, with the following characteristics:
    1. Double layer of epoxy paint
    2. Dry film thickness: not less than 80 microns
    3. Adhesion – not less than 2 N/mm² according to ISO 4624

4. Impact resistance - at least 4 Nm, according to ISO 6272
5. Scratch resistance - at least 50 N, according to ISO 1518
6. Porosity - the coating is pore-free

2.4. First flush rainwater tanks

Treatment plant for rainwater contaminated with hydrocarbons, mineral oils, and heavy sediments, of the continuous type, serving parking lots, roads, warehouses, and open storage areas, produced in an ISO 9001/2008 certified company, compliant with Legislative Decree no. 152 of 2006 and sized according to the Lombardy Regional Law of 27/05/85 no. 62 for the treatment of a rainfall flow of 5 mm from a meteorological event discharged in 15 minutes, for underground installation, consisting of:

- Smoothing manhole in polyethylene (PE) monobloc with inlet pipes, bypass for diverting water exceeding the design flow, and PVC outlet with gasket and seal, and inspection with PP manhole cover;
- Corrugated sand and other heavy sediment separator in polyethylene (PE) monobloc, compliant with UNI EN 1825-1, equipped with PVC inlet pipe with sealing gasket and 90° bend for flow deceleration and distribution, and PVC outlet pipe with sealing gasket, with T-deflector and submerged pipe; also equipped with PP biogas vent and manholes for inspections and maintenance;
- Oil and hydrocarbon separation tank in suspension, in polyethylene monobloc, certified according to UNI-EN 858-1, equipped with PVC inlet pipe with sealing gasket and 90° bend for flow deceleration and distribution, and an outlet hydraulic path with a polyurethane foam coalescence filter housed inside a removable stainless steel basket; equipped with floating shutter, PP biogas vent, and manholes for inspections and maintenance. Extensions installable on all inspection manholes, where necessary to reach the quota;

Alternatively,

- "CONTINUOUS" TREATMENT PLANT for FIRST RAINWATER, prefabricated monobloc in reinforced concrete for underground installation, made with self-compacting concrete (SCC), prepared with PORTLAND CEMENT compliant with UNI EN 197-1, with the addition of type I minerals – ventilated calcium carbonate filler and aggregates compliant with UNI EN 12620, with a compressive strength of C50/60 (Rck ≥ 600 Kg./cm²), exposure classes XC4 (resistant to carbonation-induced corrosion), XS2/XD2 (resistant to chloride-induced corrosion), XF1 (resistant to freeze/thaw attack) compliant with UNI EN 206-1, equipped with internal steel reinforcements with improved adhesion and B450C welded mesh controlled in the factory, all compliant with D.M. 17.01.2018, with external and internal surfaces finished to eliminate porosity and gravel nests, complete with:
    1. SCOURING STRUCTURE made with self-compacting concrete (SCC), prepared with PORTLAND CEMENT compliant with UNI EN 197-1, with the addition of type I minerals – ventilated calcium carbonate filler and aggregates compliant with UNI EN 12620, with a compressive strength of C50/60 (Rck ≥ 600 Kg./cm²), exposure classes XC4 (resistant to carbonation-induced corrosion), XS2/XD2 (resistant to chloride-induced corrosion), XF1 (resistant to freeze/thaw attack) compliant with UNI EN 206-1, equipped with internal steel reinforcements with improved adhesion and B450C welded mesh controlled in the factory, all compliant with D.M. 17.01.2018, with external and internal surfaces finished to eliminate porosity and gravel nests - equipped with first rainwater inlet holes and second rainwater bypass, PVC sleeve sealed for perfect hydraulic seal for

treatment delivery, internal vertical reinforced concrete baffles for flow regulation with adjustable stainless steel AISI 304 blade for weir calibration

Type: SPC-__

External tank dimensions: cm ____ x ____ x (h=___)

Weight: ql ____

- STATIC COALESCENCE CLASS I SAND AND OIL SEPARATOR compliant with UNI EN 858 with certification for non-emulsified fats/mineral oils and hydrocarbons, made with self-compacting concrete (SCC), prepared with PORTLAND CEMENT compliant with UNI EN 197-1, with the addition of type I minerals – ventilated calcium carbonate filler and aggregates compliant with UNI EN 12620, with a compressive strength of C50/60 (Rck ≥ 600 Kg./cm²), exposure classes XC4 (resistant to carbonation-induced corrosion), XS2/XD2 (resistant to chloride-induced corrosion), XF1 (resistant to freeze/thaw attack) compliant with UNI EN 206-1, equipped with internal steel reinforcements with improved adhesion and B450C welded mesh controlled in the factory, all compliant with D.M. 17.01.2018, with external and internal surfaces finished to eliminate porosity and gravel nests - complete with PVC sleeves sealed for perfect hydraulic seal for inlet/outlet pipe connections, stainless steel AISI 304 flow deflectors placed near the inlet pipe and intermediate passage between internal chambers, internal reinforced concrete partition plate sealed for hydraulic tightness to create no. 2 internal treatment chambers, oil accumulation area, automatic closing float valve calibrated for light liquids with removable coalescence filter in polyester-based polyurethane foam with defined and uniform pore structure having a porosity of 10 ppi (10 pores/inch) complete with stainless steel AISI 304 basket, steel bracket carpentry.

  Type: DSD-__

  Nominal separator flow rate (NS): ____ l/s

  External tank dimensions: cm ____ x ____ x (h=___)

  Weight: ql ____

- HEAVY TRAFFIC COVER (1st category road loads) prefabricated monobloc in reinforced concrete made with self-compacting concrete (SCC), prepared with PORTLAND CEMENT compliant with UNI EN 197-1, with the addition of type I minerals – ventilated calcium carbonate filler and aggregates compliant with UNI EN 12620, with a compressive strength of C50/60 (Rck ≥ 600 Kg./cm²), exposure classes XC4 (resistant to carbonation-induced corrosion), XS2/XD2 (resistant to chloride-induced corrosion), XF1 (resistant to freeze/thaw attack) compliant with UNI EN 206-1, equipped with internal steel reinforcements with improved adhesion and B450C welded mesh controlled in the factory, all compliant with D.M. 17.01.2018, with external and internal surfaces finished to eliminate porosity and gravel nests - complete with D400 ductile iron manhole covers

  External cover dimensions: cm ___ x ____ x (thickness=20)

  Weight: ql _____

The installation of the tanks must be carried out according to the technical data sheet.

2.5. Lamination tank

It will be made of prefabricated reinforced vibro-compressed concrete elements, with a rectangular section and net internal dimensions of 300 cm x h.150 cm x L.200 cm – thickness 20 cm, while the boxes with inlet and outlet pipes will be 300 cm x h.300 cm x L.200 cm – thickness 20 cm with High-Density Polyethylene (HDPE) Liner coating.

The concrete anchoring system must be of the T-GRIP type along the entire length of the liner, to ensure perfect anchoring to the concrete, which in pull-off tests must never give values lower than 38,000 kg/m². The internal surface of the HDPE Liner coating must be perfectly smooth, free of even minimal depressions that could negatively affect the optimal flow of the internal fluid. For this purpose, the T-GRIP anchoring must be in the same direction as the flow; therefore, anchoring systems other than the one described are not allowed. Any joint welds must be performed using extrusion technique (material addition) and not hot air, by qualified personnel (with a regular license issued by IIS of Genoa) according to UNI EN 13067 standard for Class 7 PE 7.5+3 PE 3.2 and DVS 2212:2015 for class II-1.1 to ensure absolute watertightness. To guarantee the work, all welds must be verified with the scintillograph technique, and a report must be issued certifying the positivity of each weld.

The prefabricated elements must be sized to withstand 1st category mobile loads with minimum and maximum coverings detected from the project longitudinal profile.

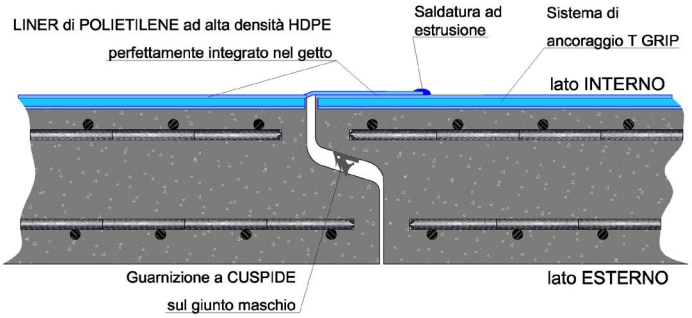
The products must comply with DM 23 June 2022 at point 2.5.3 with the revision of CAM Edilizia (Minimum Environmental Criteria for the awarding of design services and works for the new construction, renovation, and maintenance of public buildings) ensuring the use of at least 5% by weight of recycled material from primary suppliers and certified for use in concrete according to current regulations.

The prefabricated elements will be subject to CE marking according to the provisions of Regulation 305-11 EU and the related harmonized reference standard UNI EN 14844:2012 and compliant with the prescriptions of D.M. 17-01-18 "Technical standards for construction."

The reinforcements, in particular, must be made with double welded mesh and additional shaped bars or otherwise equipped with longitudinal distribution bars. (alternative devices such as steel chains, cables, or wires are not considered equivalent to reinforcement elements)

The joint system must be of the perfectly smooth interlocking type in the male and female elements, free of steps and/or ridges, to allow perfect fitting between the products.
The products must be supplied without through holes, complete with nails and handles, approved according to current safety regulations on construction sites for handling and positioning, capable of withstanding a nominal load calculated with a safety coefficient $k \geq 3$.

Any manhole inspections (upon request of circular and/or rectangular section) must be prepared with special galvanized iron templates properly fixed to the reinforcement with adequate connecting curbs, all integrated into the casting perfectly.
The support base must be made of concrete of the class and size as per the executive drawings, including the cost of level control with the aid of suitable laser equipment.
The joint between the elements must be made only using hydraulic or manual pulling equipment (TIR-FOR).



DETAIL OF WELDING OF THE JOINT

The welding of the joints, carried out on-site by our specialized personnel (with a regular license issued by IIS of Genoa), according to UNI EN 13067:2021 standards for Class 7 PE 7.5+3 PE 3.2 and DVS 2212:2015 for class II-1.1, using extrusion technique (material addition) and not hot air, to ensure absolute hydraulic tightness even under pressure. To guarantee the work, all welds will be verified with the scintillograph technique, followed by the issuance of a report certifying the positivity of each weld. Note: welds can only be performed in dry conditions.

REFERENCE STANDARDS
- DM 17.01.2018 "Norme Tecniche per le Costruzioni ";
- UNI EN 1992: 2005 - Eurocodice 2 – Progettazione delle strutture di calcestruzzo;
- UNI EN 1998: 2005 - Eurocodice 8 - Progettazione delle strutture per la resistenza sismica.
- UNI EN 14844: 2012 "Prodotti prefabbricati in calcestruzzo - Elementi Scatolari"
- UNI EN 206: 2021 "Calcestruzzo. Prestazioni, produzione, posa in opera e criteri di conformità";
- UNI EN 13369: 2023 "Regole comuni per prodotti prefabbricati di calcestruzzo"
- UNI EN 681-1: 2006 Elementi di tenuta in elastomero – Requisiti dei materiali per giunti di tenuta nelle tubazioni utilizzate per adduzione e scarico dell'acqua – Gomma vulcanizzata.

This is a cast-in-place reinforced concrete structure, subject to structural design by a designated technician, intended for water containment following a meteorological event, sized based on hydraulic invariance (following geological/geotechnical surveys, the use of modular plastic systems can be evaluated).

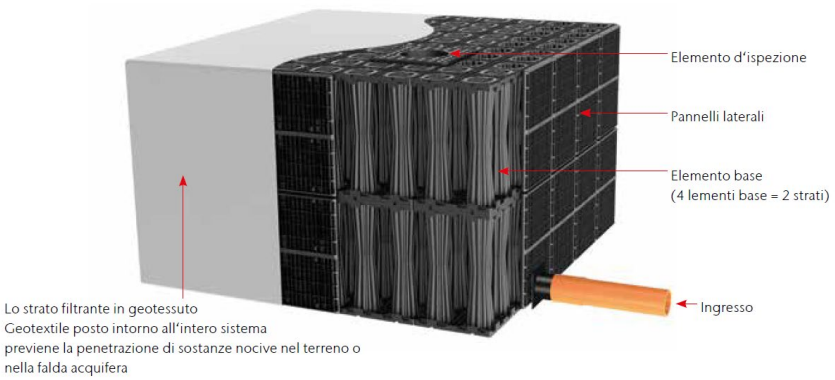
Attached to the document:
- Closed box sheets
- Integrated protection and sealing system in pipes and complete boxes, and in pipes and welded joint boxes
- HDPE T-Grip Liner
- HDPE T-Grip Liner Technical Data Sheet

2.6. Infiltration tank

Modular infiltration system made with synthetic materials ACO Stormbrixx HD900 or similar.
- Storage coefficient: 97%
- Short-term vertical compression resistance: 520 kN/m²
- Short-term lateral compression resistance: 110 kN/m²
- Non-woven fabric Geotextile robustness class: GRC 3, Weight: 200 g/m², Thickness: 1.9 mm

Operation

The ACO Stormbrixx infiltration system offers an ecologically effective solution as an infiltration system. The accumulated rainwater is collected underground in the plant, which initially stores it and then gradually releases it into the ground, thus allowing the progressive recharge of groundwater. The sizing of the infiltration system must take into account the permeability of the soil. To preserve the state of the groundwater, it is important to know the level of pollutants potentially present in the incoming water, possibly providing suitable treatment systems such as: light liquid separators, sedimentation tanks, metal and microplastic removal systems, etc.



Use and Maintenance

To manage the maintenance of the basin, we recommend the following interventions:

- Inspection and hydro-cleaning of the distribution or decantation works carried out upstream of the basins after the completion of the construction phase.
- Inspection and hydro-cleaning of the chambers after the completion of the construction phase. The condition of these will indicate whether hydro-cleaning is necessary.
- After an initial inspection, we recommend a visual inspection after 6 months. At this point, the need for a more thorough inspection and possible hydro-cleaning can be assessed. If no intervention is necessary, checks will be postponed to 12 months, until an appropriate frequency is found.
- In any case, careful control and maintenance of the decantation works and grids are recommended. These works ensure the sustainability of your basins.
- Regular control and cleaning, if necessary, of the flow limitation elements should not be forgotten.
- After a significant climatic event (e.g., a heavy storm with a ten-year return period), we recommend an inspection and possible hydro-cleaning of the work.
- The hydro-cleaning pressure will be limited to 125 bar. The recommended tool is a round head. It is important not to use sharp-edged systems that could damage the structure.

Installation Instructions

For installation, refer to the manufacturer's technical data sheet.

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Soil, wastewater and condensation pipings
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

Document: A20 ES E CM 01-

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1. INTRODUCTION

This specification details the requirements for waste, condensate and rainwater pipings.

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications.

2. GENERAL INFORMATION

The generic name of drainage refers to the pipes through which all waste water flows.
The drainage network must meet the following requirements:

- Quickly remove waste water by the shortest routes, without forming sedimentation of putrescible materials or encrustations;
- Ensure perfect sealing with joint material that has plastic properties to allow a convenient degree of joint smoothness in case of thermal variations and possible building settlements;
- Prevent the passage of fumes from the drainage networks to the environments.

Unless otherwise specified, all specified pipe dimensions are nominal internal dimensions.
The pipes must be new and supplied in rods or coils from the manufacturer, but not less than 6 meters in length, except when shorter or flanged lengths are required between fittings.

The pipes must be supplied with the manufacturer's standard finish and protection, depending on the material. Upon delivery, each pipe section must have at least one colored identification band or an identification mark. T
he pipes must be of Italian manufacture and must be identified by the appropriate "Made in Italy" label.

The pipes must be free from surface or general corrosion, harmful films, and without encrustations, pitting, damage caused by excessive weathering, or other types of damage. The holes must be clean and unobstructed. Any damaged pipes must be removed from the site and replaced. The pipes must be stored off the ground on flat and level surfaces or on packaging. The area must be free of protrusions that could damage the pipes.
Pipes stored outdoors must be adequately covered and protected from the weather.

Materials must be stored in dry conditions to prevent damage or corrosion. The site management will reject improperly stored material.

3. CONSTRUCTION FEATURES

The piping for the different drainage networks will be installed according to the specifications below.

3.1. Table of materials

The drainage system must use pipes made of the following plastic materials.

Internal waste pipings branches and risers must be constructed from high-density HDPE or heavy-duty soundproofed PVC (embedded in the slab, in the floor screed, or on the ceiling below).
Alternatively, CAST IRON may be used.

A secondary ventilation system for WC will be made of PVC pipings.

Condensate drainpipes shall be made of sealed PVC or PE.
Horizontal condensate collector pipes shall be made of welded PEAD or PE.

Internal rainwater drainage branches, risers, and horizontal collectors must be constructed from welded HDPE or heavy-duty PVC.

Drainage type	Material
Sanitary waste pipes and other waste discharges with a maximum continuous temperature of 70°C, internal networks	Welded HDPE/CAST IRON
Waste pipes with a maximum continuous temperature of 120°C	PP
Secondary ventilation pipes	PVC
Rainwater pipes	PVC/HDPE
Exposed condensate pipes	Sealed PVC
Embedded in the slab condensate pipes	Welded HDPE /PE

3.2. Installation of pipework

Pipe work shall be installed in the positions and to the sizes indicated on the drawings in accordance with the recommendations of UNI EN 12056.
Horizontal pipe work shall be installed to the gradients shown on the drawings, but in general not flatter than 0.5%.
Fittings shall be provided on all vertical pipe work at each storey level above the spill-over level of the highest appliance or fitting connected to the vertical pipe work at that particular storey.

Ventilation pipes shall be carried to atmosphere full bore terminating 500 mm above roof level not within a horizontal distance of three metres or less than 1000 mm above the head of any openable window or maintenance path. The pipe shall be provided with a vent cowl.
In the case of uPVC stacks the contractor shall, in the production of installation/working drawings and the execution of the works, consult the manufacturers' recommended guidelines for installing solvent welded uPVC to ensure adequate provision, by the use of the appropriate fittings, is incorporated in all pipe work systems for the compensation of thermal expansion.

Installation methods according to the recommendations of the Italian Plastics Institute, contained in the publications:

- No. 3 for PVC pipes for underground drainage networks;
- No. 8 for PVC pipes for drainage networks inside buildings;
- No. 11 for HDPE pipes for underground drainage networks.

For other pipes, follow the manufacturers' instructions.
Pipe expansions must be absorbed by Z-shaped movements in the case of free pipes or by expansion joints in the case of structural or distribution constraints.
The systems must be calculated based on the coefficients indicated by the various manufacturers. Similarly, at the crossings of the building's structural joints, flexible joints with sufficient play must be provided to compensate for relative movements.

At the crossings of fire compartment walls or floors, fire sleeves in galvanized steel with intumescent lining, approved for a minimum of REI 120, must be provided.

3.2.1. Labeling

Pipes must be marked with the following information:

- reference standard
- manufacturer's mark
- material
- application

- pipe series
- external diameter and wall thickness
- manifacturing date
- quality mark

Fittings must be marked with the following information:
- reference standard
- manufacturer's identification
- material
- application
- nominal diameter and angle
- production date
- quality mark

3.2.2. Shipping and storage

During transportation, pipes must be stacked in an orderly and rational manner, ensuring that they are supported along their entire length and handled during loading and unloading operations in a way that avoids violent impacts, abrasions, or deformations.
On site, handle pipes and fittings with the same care, always in a way that avoids any possible alteration of the products.
Store pipes in the most protected environment possible (from the weather, direct sunlight), resting them on horizontal and uniform surfaces, avoiding the formation of stacks higher than 1.50 meters.
Loading and unloading operations must be carried out carefully. Pipes must not be dropped or dragged, but must be carefully lifted and placed.
If the pipes are not used for a long period, they must be protected from direct sunlight.

3.3. General specifications for wastewater and rainwater drainage systems

The minimum diameter for the toilet drains (equipped with a 9/3 liter dual-flush cistern and wall discharge) will be 110 mm. Secondary ventilation will be provided on the PVC toilets, according to UNI – EN 12056 standards. Siphoned floor drains will be installed in the technical rooms and restrooms (where required).
At the base of all columns and where required by best practices, traps and inspection tees will be installed. They will be complete with special parts, expansion joints, and, where necessary, electrical sleeves. At each new connection, a 45° inspection tee with a bend will be provided to facilitate the flow of liquid.
On the black water pipes, particularly at the base of the vertical columns, inspections must be inserted, made using a special T-piece with a threaded cap for hermetic sealing of the same diameter as the pipe to be inspected. The drains will be properly insulated to contain noise and equipped with static vents at the top, with protection to prevent the entry of rainwater.
The pipes intended for SOUNDPROOF drainage systems inside buildings must comply with DIN 4109 (together with DIN 52219) and UNI EN 14366 "Laboratory measurement of noise emitted by wastewater installations" standards. Each sanitary fixture must be equipped with a hydraulic closure device, inserted on the drain, inspectable, and connectable to the ventilation branch.
The drainage collectors must be equipped, before their connection to the external outlet, with a suitable inspectable hydraulic closure device with a ventilation connection.

At the base of all columns (and where required by best practices) of the rainwater drainage networks, traps and inspection tees will be installed. All pipes must be marked with the IIP conformity mark to UNI standards.

3.4. Condensate traps, general

Provide traps to all condensate producing plant and equipment.
Ensure all traps have seal depths and diameters in accordance with UNI EN 12056.
Where traps are likely to operate in seasonal conditions where condensate is not produced in adequate quantity to replenish water seals a secondary waterless means of automatic sealing shall be provided integral to the trap with a visual indication of its operation.

All traps shall either have provision for cleaning the downstream pipework via a rodding eye.

All traps shall be capable of disassembly for cleaning.

Traps and Pipework to Air Handling Units
Provide the trap with a means of filling and incorporate couplings to facilitate removal for cleaning. Locate the trap in an easily visible and accessible position, with suitable protection against accidental damage. Ensure the pipework connecting into the drainage tray of the air handling unit has a continuous fall of not less than 1:20.
Size the depth of the water seal in the trap to suit the positive or negative fan pressures of the air handling unit at the highest unit differential pressure with dirty filters. For trap locations and depths of water seals refer to the mechanical engineering specifications/drawings.
Select trap diameters to ensure all condensate can be discharged under maximum operating conditions, subject to a minimum size of 25mm diameter.
Ensure water from each trap discharges via a clear air gap of at least 15mm above the unrestricted spill-over level of either an open tundish connected to a foul drainage stack by way of a second trap, or a floor gully (or channel). Provide a support to ensure that the air gap cannot be reduced. More than one drain trap may discharge into the tundish providing each has its own air-break.
Provide drainage pipework of either thermoplastic (ABS), copper or stainless steel. Ensure the pipework has a minimum diameter of 25mm and a fall of at least 1:60 in the direction of flow. Ensure the pipework is well-supported and located so as not to inhibit access to the air handling unit.
Trace-heat traps fitted to plant located outside or in unheated plantrooms. Ensure the trace heating does not raise the temperature of water in the trap above 5oC.
Insulate traps and pipework as specified in specification section for cold water.

Traps and Pipework to Fan Coil Units/DX internal units
Provide a gravity condensate drainage system from each fan coil unit/DX fancoil unit. .
Ensure that the diameter of the drainage system pipework is greater than or equal to the diameter of the condensate drip tray outlet connection.
Route condensate drainage pipework with a continuous gradient through a type A air gap created by the provision of a tundish to connect to the foul drainage system via a waterless trap.
Insulate traps and pipework.
Provide drainage pipework of either thermoplastic (ABS), copper or stainless steel, with long radius bends and access points at changes in pipe direction/size.
Provide a minimum gradient of 1:20 wherever practicable in the condensate drainage pipework. Test the adequacy of the drainage whenever a 1:20 gradient is not practicable and a shallower gradient has been used, by filling each condensate tray with water and ensuring that it drains completely, without any leaks.
Size the depth of the water seal in the trap to suit the positive or negative fan pressures of the air handling unit at the highest unit differential pressure with dirty filters. For trap locations and depths of water seals refer to the mechanical engineering specifications/drawings.

3.4.1. Unit and construction

Cleaning
Properly clean all traps, pipework and fittings.
All condensate trays shall be cleaned to remove all construction debris.

Painting and Installation
Off-site painting and anti-corrosion treatment
Apply a protective coating at works to all ferrous materials where it is normal custom to do so.
Make good defects to coatings prior to installation.
Prior to testing make good damage to coatings occurring during installation.
Inspect condensate tray finishes (insulation, anti-corrosion finishes) and rectify.

Fixing to Building Fabric
Fix pipes at centres not greater than those specified by the current regulations Provide additional supports as necessary at junctions and changes in direction.
Where not specified otherwise, use plated, sherardized, galvanised or non-ferrous fastenings, suitable for the purpose and compatible with the materials being fixed to one another.
Fix all pipes in straight runs and lay all horizontal runs to gradients in excess of the minimum gradients stated in UNI EN 12056.
Ensure brackets used for uPVC pipework and fittings internally are made of mild steel, protected from corrosion by plastic coating or galvanising. Ensure brackets have a two-position fixing suitable for either acting as a pipe support, but allowing thermal movement, or as a clamp fit on a fitting creating a fixed point. For optimum fit to pipe supports, PVC packing pieces may be used.
Provide pipe brackets for stainless steel pipework that are 2-piece, rubber lined clips with back fixing nuts to take M8 or M10 threaded rods. Ensure that the brackets are manufactured from galvanised steel or stainless steel, where considered necessary.
Sleeve pipes passing through walls or floors to allow unrestrained movement.
Where horizontal pipes are located in excess of 300mm from the soffit, provide adequate supports to prevent lateral movement.

3.5. External soil and rainwater pipework and components

Please refer to document: *4025 ES E CM 99.*

4. MATERIAL FEATURES AND PIPING INSTALLATIONS

Le tubazioni per le varie reti saranno realizzate come sotto specificato.

4.1. HDPE Pipings

Supply and installation of high-density polyethylene pipes and fittings for sewage and underground non-pressurized drains, compliant with UNI EN 12666 standard. The pipes, which must be produced by a company with a system certification in accordance with UNI EN ISO 9001:2008 and UNI EN ISO 14001:2004, must bear the full conformity mark issued by a third-party certification body accredited according to UNI CEI EN 45011 and 45004 standards (product conformity certification). The internal and external surfaces of the pipes and fittings must be smooth, clean, and free of cavities, bubbles, impurities, and any other surface irregularities that could affect compliance with the standard. The pipe ends must be cut cleanly and perpendicularly to the pipe axis; the edges of spiral pipes, which may be sharp once cut, must be rounded.
Where lifting stations are present, the downstream system will use high-density polyethylene pipes for sewage and underground pressurized drains, supply and installation of high-density polyethylene PE100 pipes, solid wall type 1, for water transport networks for underground and above-ground applications of raw water before treatment, for pressurized drains and sewers, for vacuum sewer systems and water for other purposes, black or black with coextruded brown stripes, pigmented and stabilized in granules at the origin, with a nominal external diameter of DN……mm, SDR …. (PN …), fully compliant with UNI EN 12201-2 standard with a conformity mark issued by a third-party certification body accredited according to UNI CEI EN ISO/IEC 17065/2012 and UNI CEI EN ISO/IEC 17020/2012 standards (product conformity certification). The pipes will be produced by a company with the following management systems:

- QUALITY according to UNI EN ISO 9001:2008
- ENVIRONMENT according to UNI EN ISO 14001:2004
- SAFETY according to BS OHSAS 18001:2007

certified and validated by an accredited third party.
They must be SDR 17 PN10 pipes.
The internal and external surfaces of the pipes and fittings must be smooth, clean, and free of cavities, bubbles, impurities, and any other surface irregularities that could affect compliance with the standard.
The pipe ends must be cut cleanly and perpendicularly to the pipe axis; the edges of spiral pipes, which may be sharp once cut, must be rounded.

4.1.1. Joints

The following methods of tensile-resistant joints (connections that cannot be separated by tension) are allowed:

- Butt welding
- Joining with electrofusion coupler

However, fittings or special parts made of other materials (polypropylene, acetal resins, metallic materials) provided in the project and deemed suitable by the Site Supervisor Manager must be used.
For diameters up to 110 mm, special couplers with an O-ring seal and stop ring are used for butt joints between pipes. Before welding, polyethylene pipes must be perfectly cleaned with appropriate equipment from any foreign material that could impair the future operation of the pipeline. The cleaning of the welding ends must be done both externally and internally for at least 10 cm in length. Any deformations or flattening of the ends must be eliminated by cutting or corrected using the jaws of the welding machine. The surfaces to be connected with an electrofusion coupler must be prepared exclusively with a special mechanical scraper to remove any oxidation from the pipe surface.
The machines and equipment used for the assembly of polyethylene pipes must be previously approved by the Site Supervisor Manager. The pipes to be welded must be supported on special rolling supports and held by the same equipment in a perfectly coaxial position. Before welding, if the faces to be joined are not perfectly parallel and matching, the ends must be faced with a special wheel tool to meet this requirement. Before welding, the pipes must be perfectly dry, free of

any traces of moisture. During welding and for the entire cooling time, the affected area must be protected from direct sunlight, rain, snow, wind, and dust.
The allowable ambient temperature range during operations must be between 0 and 40 degrees Celsius. After welding, the protection must ensure gradual cooling, and the pipe clamping system on the welding machine must ensure a firm position until cooling. The weld bead section must be uniform, with constant surface and width, without evidence of blowholes or other defects. At the end of the welding operations, a suitable expansion plug must be placed on the last pipe end to ensure the maintenance of cleanliness inside the pipeline.

4.1.1.1. Butt welding

Thermal element contact welding must be carried out by personnel holding certification (license) in accordance with UNI 9737, issued by an accredited personnel certification body, and performed in compliance with UNI 10520 and UNI 10967 standards as applicable, and UNI 11024.
Equipment conforming to UNI 10565 must be used.
Before proceeding with welding, it must be verified that the surfaces of the pipes to be butt-welded are cut perpendicularly to the axis, free of defects, and clean.

4.1.1.2. Joining with electrofusion coupler

Electrofusion welding must be carried out by personnel holding certification (license) in accordance with UNI 9737, issued by an accredited personnel certification body, and performed in compliance with UNI 10521 and UNI 11024 standards. Equipment conforming to UNI 10566 must be used.
Before proceeding with welding, the scraping with an appropriate tool and cleaning of the fusion surface of the spigot must be carried out.

4.2. PVC pipings – series SN

PVC (polyvinyl chloride) pipes for sewage must, where not specified in this regulation, comply with the requirements of UNI EN 1401 regarding types, dimensions, and characteristics.
The standard considers three types (or series) of pipes: SN2, SN4, SN8, corresponding to three different thickness series.

The series to be used is SN4 for ventilation ducts.
The series to be used is SN8 for discharge ducts.

The Contractor is required to inform the Project Management before proceeding with the supply, of the factories from which he intends to procure the materials and their characteristics. Pipes and fittings must be marked with the IIP conformity mark owned by the Italian National Unification Body UNI, managed by the Italian Institute of Plastics.

The Project Management reserves the right, for the acceptance of the supply, to carry out or have carried out all the tests it deems necessary, which will comply with the aforementioned regulations.

4.2.1. Joints

The connection between the various PVC pipes will be made using socket joints or axial sliding couplings with sealing by elastomeric gaskets.

The ends of the pipes will be properly beveled, the walls to be joined will be thoroughly cleaned, and the inner surface of the gasket will be lubricated with a suitable lubricant. The pipe will then be inserted into the socket or coupling, ensuring that at least 1 cm remains between the end of the pipe and the stop point

4.3. U-PVC pipings

Waste and ventilation pipes and fittings, etc., shall be unplasticised PVC and conform to UNI 10972, UNI EN 1401: Plastics piping systems for non-pressure underground drainage and sewerage - Unplasticized poly(vinyl chloride) (PVC-U) and UNI EN 1329: Plastic piping systems for soil and waste discharge within the building structure. Unplasticized poly(vinyl chloride) PVC-U. Specification for pipes, fittings and the systems.
Vertical uPVC pipe work shall be supported with galvanised mild steel holderbats of either the built-in type or screw-to-wall type, positioned at sockets where expansion is required to be compensated and at intermediate points so that support distances do not exceed 1.8 metres.
Horizontal uPVC pipe work shall be fixed with self-drilling anchors to concrete soffits to which 8 mm diameter threaded drop rods shall be attached. To these drops galvanised mild steel support brackets or thermal movement limiters shall be attached, as applicable.
In all cases packing pieces shall be used with galvanised mild steel holderbats for optimum fit.
Horizontal branch waste pipe work shall be supported with pipe clips and brackets.
Where boss or branch connections are made to soil or waste stacks, the distance between the entry and the nearest fixed point shall not be less than 500 mm.
Expansion joints in general shall be provided at a maximum of 4 metre centres for soil pipe work and 2 metre centres for waste pipe work and between fixed points over 1 metre apart. Pipe work shall not be inserted fully into expansion fittings. A sufficient gap shall be allowed to allow lateral movement of the pie into the socket of the fitting.
Pipe sleeves for building into walls and floors, etc., shall be the same material as that of the pipe to be sleeved and shall be one size larger than the pipe diameter. Where these occur within a fire compartment, fire stopping shall be provided within the sleeve to provide the same integrity as the compartment.

4.3.1. Joints

All joints on uPVC pipe work and fittings, except where expansion must be catered for, shall be solvent welded. All surfaces to be joined shall be cleaned prior to coating the contact surfaces with solvent weld cement, using a clean brush. The joint shall be assembled immediately, removing excess cement and shall be left to set for twelve hours before testing for water tightness. Where pipe work is to be cut, a patent pipe cutter, designed for cutting plastic pipe, shall be used to ensure the cut is square. Pipes burrs and swarf removed to ensure pipe and bore are clean.

4.4. PP pipings

Soundproof drainage system consisting of pipes, fittings, and accessories for indoor building drainage, made of halogen-free homopolymer polypropylene with mineral fillers.
Manufactured and certified by major international bodies in accordance with EN 1451-1, suitable for fluid drainage, compliant with ISO TR 10358, at atmospheric pressure with a maximum temperature of 80°C in continuous operation and 95°C in intermittent operation, with a pH between 2 and 12.
Minimum operating ambient temperature of -20°C.
To be used in the construction of drainage systems inside buildings or externally anchored to walls (application area B), or directly embedded in concrete; also suitable for the construction of ventilation and rainwater drainage systems and vacuum suction systems.

The drainage system has a sound level Lsc,A of 6 dB(A) measured at a flow rate of 2 l/s for a De 110 system according to EN 14366 and certified by the Fraunhofer Institute for Building Physics in Stuttgart (P-BA 223/2006).
Technical data: Density at 23°C >1600 kg/m³, melt flow index (230°C - 2.16 kg) <5 g/10 min, elastic modulus 2800 MPa, yield strength >14 MPa, elongation at break >80%, linear expansion coefficient 0.08 mm/m·°C. Fire reaction class Euroclass C-s3, d0 according to EN 13501-1

Properties	Value	Testing
Pipe material	Polypropylene and mineral filler blend	-
Fitting material	Polypropylene and mineral filler blend	-

Properties	Value	Testing
Gasket material	SBR	-
Color	RAL 7035	-
Dimensions	58÷160 mm	-
Application	Low and high temperature drainage systems inside buildings or anchored externally to building walls (application area B) or laid directly in concrete; ventilation networks of drainage systems; non-pressurized rainwater evacuation systems.	-
Connections	Socket joint with gasket	-
Minimum operating temperature	-20°C	-
Maximum discharge temperature	+95°C (intermittent operation) +80°C (continuous operation)	-
Minimum pressure	-500 mbar	-
Maximum pressure	+1,5 bar	-
Discharge composition	pH 2÷12	-
Acoustic performance Density at 23°C Modulus of elasticity	LSC,A = 6 dB(A) at a flow rate of 2 l/s, measured on the basement floor, behind the installation wall with 2 clamps per floor.	EN 14366
	LIN = 9 dB(A) at a flow rate of 2 l/s, measured on the basement floor, behind the installation wall with 2 clamps per floor	DIN 4109
	Rw+ Ctr 46 without pipe coating and with a wall composed of 13 mm of plasterboard and 75 mm R1.5 insulation, evaluation carried out at a flow rate of 2 and 4 l/s.	Building Code of Australia (Part F5.6)
Yield strength	1600 kg/m3	UNI EN ISO 1183-2
Elongation at break	2800 MPa	ISO 527-2
Crystal melting temperature	≥ 14 MPa	ISO 527-2
Coefficient of linear thermal expansion	≥ 80%	ISO 6259-3
UV resistance	≥ 160°C	ISO 11357-3
Halogen content	0,08 mm/m·K	-
Fire behavior	Suitable for outdoor use (4). Suitable for outdoor storage (for periods not exceeding 18 months).	-
Reference construction standards	Halogen-free	-
Pipe material	Fire classification C-s3,d0	EN 13501-1
Fitting material	EN 1451-1 - WMTS-508:2013 - NBK 19	-

4.4.1. Joints

Joints can be made with push-fit sockets equipped with elastomer gaskets.

4.5. Cast iron

Supply and installation of pipes, fittings, joints, and accessories for cast iron sewage discharge in compliance with the European standard EN 877.
All pieces will be made of ductile cast iron with metallic joints equipped with elastomer sleeves.
The interior of the pipes, coated with very compact and perfectly smooth cement mortar, facilitates flow, resists abrasion, and has good resistance to chemical attack.
Externally, the pipes will have zinc galvanic protection and a red epoxy paint to ensure the integrity of the pipes.
In terms of fire reaction, the cast iron pipes and related fittings/accessories must comply with the Euroclass classification: A1 or A2-s1, d0.

4.5.1. Joints

The connection between the various cast iron pipes will be made using metallic joints equipped with elastomer sleeves that ensure the system's watertightness.
The joints must be selected to account for hydrostatic pressures in areas subject to overloads to ensure their sealing and mechanical stability.

4.6. Floor siphon trap

Floor siphon trap in PE with edge and inlet funnel in PE, stainless steel grid, adjustable side inlet, discharge diameter as indicated in the material list.

Cover characteristics:
- Type of cover: Slotted grid
- Cover material: Stainless steel 14301
- Cover color: Silver
- Cover width: 120 mm
- Cover height: 16 mm
- Cover length: 120 mm
- Surface: Polished stainless steel
- Frame material: ABS
- Closure lid: Unlocked
- Load class: K 3 (EN 1253-1)
- Frame length: 130 mm
- Frame material: 130 mm
- Riser shape: Angular
- Riser material: ABS
- Odor trap: Included

4.7. Inspection and connection pits

Connection pit, made with prefabricated vibrated concrete elements with side impressions for the insertion of pipes, without cover or grid, installed including all charges and expertise for the watertight connection with the pipes, etc., including excavation, backfilling with concrete, and refilling.

4.8. Rainwater outlets

Rainwater outlets shall be of the type as indicated on the drawings and in the project documents. Protection of rainwater outlets after installation shall be provided and carried out by the contractor. They shall be kept free from all debris and building materials and maintained clean at all times throughout the contract.
After they have been installed any damaged or broken gratings shall be replaced by the contractor at no extra cost to the contract.
Where chute outlets to hopper heads are installed the chute outlet through the parapet shall be lead formed to the engineer's detail, dressed into the head of the outlet downpipe installed by the contractor.
The hopper heads shall be complete with copper wire gratings. Trapped rainwater outlets will be provided to public walkway areas.
Hopper heads and chute outlet lead splays or roofing felt drips are to discharge completely into the outlet. The Contractor is to liaise with the appropriate installers/Contractors to ensure and agree this requirement.
Channel gratings, fixings and expansion joints are to be in accordance with details and installed to the locations as indicated on the Contract Drawings, in the Project documentation and in accordance with the manufacturers' details.

They can be of the following types:
- Polypropylene siphon cover with grid for water drainage, installed on a rubber spigot.
- ABS siphon cover with chrome grid for water drainage, installed on a rubber spigot.

The rubber spigots must be:
- EPDM rubber spigot with a notched square flange and a 200 mm high spigot, conical at the bottom and cylindrical at the top;
- EPDM rubber siphon spigot with a notched square flange and a 200 mm high spigot, conical at the bottom and cylindrical at the top, complete with a dome for siphoning and a leaf guard grid;
- Thermoplastic rubber spigot with a notched round flange and a 170 mm high spigot.

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Irrigation system
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

Document: A21 ES E CM 01-

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1. INTRODUCTION

This specification details the requirements for Irrigation system.

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications.

2. GENERAL INFORMATION

Below are the characteristics that the automatic irrigation system must have.

The irrigation system aims to irrigate the different types of greenery provided: sprinklers for lawn areas, drip irrigation for tree rows and shrub areas. Additionally, supplementary points can be provided where gate valves with quick-connect fittings (e.g., rubber hoses and hydrants) can be placed for emergency irrigation. The goal of creating an irrigation system is to provide a daily amount of water sufficient to ensure perfect rooting and subsequent development of the planted botanical species, using the following indicative parameters:

- 5 mm for the lawn;
- 8/16 mm for shrubs;
- 40/60 mm for tree species.

These are maximum values relative to the irrigation season.

2.1. General

The system, in general, will be composed as follows:

- Connection to the general water network or a first aquifer extraction well;
- Primary and secondary water distribution pipes;
- Sector gate valves and solenoid valves;
- Static, dynamic sprinklers, drip lines, and flooders;
- Connection to the electrical network necessary for the operation of the solenoid valves;
- Electronic programmer powered by 220 Volt electricity or battery;
- Possible telephone connection.

It is specified that the related meters (water, electricity, and telephone line) will be dedicated to the system. The control panels (programmers) and connections must always be independent and located in spaces separate from all other constructions in the area.

For detailed execution, refer to the attached project documents.

2.2. Excavation works

The excavation works for laying the pipes must ensure the sections provided in the price articles.
Excavations in flower beds will be limited to the strictly necessary and will be carried out with a rubber chain trencher and/or excavator. The machines used for these works must not damage the plants or masonry works and must be sized proportionally to the work to be performed, so as not to excessively burden the soil.

2.2.1. Backfilling

All main pipes must be placed on a layer of fine sand with a thickness of 5-10 cm to prevent damage due to compression.
Once the installation of the pipes, cable ducts, and other system components is completed and after connecting the pipes and wires, partial backfilling of the excavations will be carried out using the following materials:

- Loose soil from the excavation from which stones or debris have been removed;
- Fine sand if the excavated material is not suitable for protecting the pipes and other system components.

The backfilling must follow immediately after the installation of the components to leave the least number of free cavities in the ground.
When electrical cables with conduits are to be laid in the same excavation, a first partial backfilling by hand must be carried out, and a warning and protection net with a width of not less than 20 cm must be laid on this, and then the filling must be completed by machine.
The conduits must be placed at a higher level than the pipes.
The backfilling of the soil must be done in such a way as to make the surface perfectly level with the original level. Any remaining soil, stones, or other debris must be removed and taken to a landfill.
The covering of porous pipes and drip lines will be done by hand to avoid breaking the delivery lines.

3. TECHNICAL FEATURES

3.1. Pipings

All pipes must be made of high or low-density polyethylene.
The relative pressure losses must be calculated based on the required unit flows, and consequently, the most appropriate pipe section must be chosen.
Following the above calculations, the layout of all pipes and their dimensions must be shown on the project plan. For all pipes, the PN (nominal pressure) value must be consistent with the maximum pressures assumed in the pipes.
The pipes must comply with UNI standards that meet the health regulations of the Ministry of Health regarding products for food liquids (Ministerial Circular No. 102 of 02/12/1978 for polyethylene pipes, UNI 10910 high-density pipes – UNI 7990 low-density pipes).
If pipes in bars are used, the personnel responsible for welding the polyethylene pipes must have the specific "polyethylene welder" license as per UNI 9737+ FA-1 standards.
The routing of the pipes must generally follow the project plan unless specific logistical situations prevent it: in any case, changes to this route cannot lead to price revisions unless significant variations (greater than 50% of the excavation sections indicated in the articles) are required, for example, in the depth of the excavations, in the backfilling of the pipes, in their protection, or when obstacles underground necessitate changes to the materials themselves.
All pipes must be installed according to the manufacturer's instructions at the previously indicated depths.
Any bends, both horizontal and vertical, must fall within the tolerances indicated by the manufacturer. Under no circumstances should bends other than those allowed by the catalog be made by heating or mechanically forcing the pipes.
In situations where the pipes need to be protected, they should never be directly backfilled in concrete (CLS), but protected in iron or PVC conduits, subsequently backfilled in concrete. For road crossings, the pipes must be protected by conduits to avoid crushing and facilitate possible replacement without breaking the overlying structures.
At the end of each workday, all free pipe ends must be closed to prevent the entry of foreign material. Any differences in the laying levels found compared to those established above must be corrected by bringing the excavation to the correct laying level.
If particular subsoil conditions do not allow compliance with the established level, timely notification must be given to the Clerk of Works (D.L.), and appropriate decisions must be made in agreement with them regarding raising or changing the route to be followed by the pipe. In any case, this cannot be used as a pretext for requesting a price change. For the sub-irrigation of trees, the drip ring must be buried and protected inside a drainage pipe equipped with a T-joint with a minimum diameter of 32 mm. These pipes, thus composed, will be laid at a depth of 40-50 cm on a layer of fine soil and covered.

3.2. Fittings

The various fittings for joints, branches, and bends between polyethylene pipes will have an adequate PN to avoid breakage caused by water hammer and can be of the electrofusion or compression and clamping type in bronze, cast iron, or plastic materials in the appropriate diameters depending on the pipes to be connected. The fittings for polyethylene pipes to be welded will be of the same type and will be assembled to the pipes using a special welding machine.

3.3. Gate valves

All isolation gate valves provided in the system must be of the inline model with body and cover in GS400-12 cast iron coated with epoxy resin, stainless steel operating stem, and wedge of the same material coated with nitrile rubber. Flange drilling PN 10 according to international template. The connection of the gate valves between the valves and the pipes can be made using movable flanges with welded collars or flanges with clamping rings. In any case, the necessary bolts for coupling must be stainless steel and the fittings in FeZn. All gate valves must be installed with ground anchoring, on a concrete base, and enclosed within manholes. The connection between the valves and the pipes can be made either using movable flanges with welded collars or flanges with clamping rings. In any case, the necessary bolts for coupling must be stainless steel.

3.4. Isolation valves

Body in cast bronze and diaphragm reinforced in high-strength nylon and Buna-N (25 atm).
Low amperage reinforced solenoid for heavy-duty service with slow closing to prevent water hammer.
Equipped with a flow regulation system and manual opening.
They will be mounted paired with manual safety valves between two union joints to allow their quick removal.

3.5. Drain valves

In each section of the supply line between two isolation gate valves, a manual drain valve must be provided, housed in an easily identifiable manhole to allow opening and closing operations using a control rod. For each manifold formed by multiple solenoid valves, an appropriately sized drain valve must be inserted.

3.6. Automatic drain valve

For each individual irrigation sector, an automatic drain valve in brass or stainless steel must be provided. This valve automatically empties the pipes at the end of each irrigation cycle. It must be installed at the lowest points of the line and oriented downwards.
For proper installation, the use of a manhole with gravel drainage is recommended.
The valve allows water to exit at a pressure below 0.2 BAR and closes at a pressure above 0.4 BAR.

3.7. Volumetric meter

Branching from the connection to the water network or the first aquifer extraction well, protected upstream by an exclusion gate valve, a volumetric meter must be placed in a dedicated manhole.
This meter will be electrically connected to the control unit and able to communicate to the relevant peripheral unit the water flow passing through during the entire irrigation cycle for each sector, allowing constant monitoring of the system's operation.
This flanged meter must be connected with stainless steel bolts to prevent corrosion. Downstream of this, a Master exclusion solenoid valve must be installed. Both must be connected via bipolar conductors to the relevant peripheral unit.
The volumetric meter will be certified according to CEE/ISO class B standards to be compatible with the detection and transmission peripheral defined below as the control interface, or with the field peripheral units defined below as programmers.
The meter must guarantee an electrical pulse every 10 or 100 liters. The diameter of the meter must be proportionate to the water demand specified in the project.
The pulse volumetric meter must be able to provide the centralized irrigation system with the volume of water actually delivered, thus highlighting any discrepancies with the expected water flow and indicating potential damage to the distribution network or the irrigation bodies. The volumetric meter must also have an ON/OFF contact, a plastic-coated cast iron body, a "dry" type clockwork, a removable measuring group, and a flanged connection.
The meter must be installed complete with hydraulic connection fittings and electrical connections to the detection system.

3.8. Electric valves

The MASTER solenoid valves and sector valves must be either in Nylon with fiberglass or in bronze and must guarantee an operating pressure of at least 10 BAR. The solenoid valves must be equipped with a flow regulator to allow flow adjustment based on pressure; a manual opening device; and a filtration system using a labyrinth filter placed on the membrane; prepared for the installation of a pressure regulator.
The screws and metal parts will be stainless steel. The fittings for inline and angle mounting are usually susceptible to water hammer; to avoid this problem, both opening and closing must be "delayed," while the solenoids must be low voltage (24 V) and have low power consumption at opening (0.41 A) and in operation (0.23 A).
The diameters of the solenoid valves for the various sectors must be chosen in relation to their flow rates, taking into account localized pressure losses, which can be determined using the relevant solenoid valve tables. The solenoid valves must have characteristics that ensure perfect hydraulic and electrical operation if integrated into the municipal management network, with the programmers and management system already installed by the Parks and Gardens Department.
Each solenoid valve must be hydraulically sectionable upstream, using a threaded ball valve with a stainless steel stem and a square head, designed for operation from outside the manhole, using an extension of the operating lever. Each solenoid valve must be removable from above using three-piece joints with flat connections to be placed upstream and downstream of the solenoid valve itself, all to ensure the removal of the solenoid valve body without having to tamper with the manhole or the pipe connected to it.
The fittings must be in FeZn because they are more resistant to the pressures in the pipes. The diameter of the fittings, gate valves, and unions that make up the distribution group upstream of the solenoid valves must be at least the section of the largest pipe downstream of the solenoid valves. The derivation of the gate valves from the collector group must be done using a special union of the same diameter as the solenoid valves; similarly, the connection between the solenoid valve and the junction fitting with the pipes of the individual sectors must be made to ensure the removal of the solenoid valve body without having to tamper with the manhole or the pipe connected to it.

3.9. Pits/Manholes

They can be rectangular and built in masonry with galvanized iron covers, painted green, driveable, or made of green plastic material; they must have a cover with a lock and a square nut, the same for all manholes, for easy access to the sectional valves and fittings. They will be placed in dry areas, and positioning in places where water can stagnate is not allowed.
The FeZn cover of the masonry manholes must be brought to the finished ground level and must be sufficiently robust to withstand the weight of maintenance vehicles, thus driveable. The bottom of the manholes, leveled and cleaned, must be covered with a layer of gravel to facilitate drainage. The housing manholes for bronze hydrants and automatic drainage valves will be circular.

Types of manholes:
Masonry manholes:

- 70 x 50 cm for collectors of 2 solenoid valves;
- 80 x 80 cm for collectors of 3 solenoid valves;
- 100 x 80 cm for volumetric meter and master valves.

Resin manholes:

- 500 x 400 mm rectangular manhole;
- 600 x 500 mm rectangular manhole;
- Ø 200 mm circular manhole;
- Ø 300 mm circular manhole.

Manholes for electrical line inspection and drain valves:

- 30 x 30 cm in masonry with a concrete cover.

Installation of manholes:
Masonry manholes for solenoid valves:
- in masonry and with gravel drainage at the bottom.

Nylon-fiberglass manholes for solenoid valves:
- these manholes must also have a drainage system at the bottom.

Manholes for volumetric meters, master valves, and solenoid valves:
- in masonry and with gravel drainage at the bottom. All manholes and any openings related to the conduits must be properly sealed to prevent rodent access to protect the pipes and electrical cables; these works are included in the price. The manholes must not rest directly on the pipes but will be appropriately shaped to embrace the pipes.

3.10. Electrical conduits

Depending on their function, they must comply with current regulations and be divided as follows:
- Cables for 220V current: single-core cable with double insulation, insulated in non-flammable polyethylene N1VV-K UNEL 35756, with a section not less than 2.5 mm². 3M type joints, to be made inside an inspection manhole.
- Cables for solenoid valves: double-insulated cable with polyethylene coating, with rigid conductor, UR2 R/4, with a section equal to or greater than 1.5 mm², according to CEI 20-14 UNEL 35379 and 35743 standards, to be installed in a single section, without joints, from the programmer to the solenoid valves.
- Cables for telephone lines: a pair of wires plus ground insulated with thermoplastic material, not buried, under a thermoplastic sheath with a conductor diameter of 0.6 mm², shielded and armored, tinned, in compliance with CEI 46-5, CEI 2022, UNEL 36713/36754 standards.
- Communication cables: The communication cables between the programmers of the centralized system and its other components must be of the System Cable type.

All electrical cables connecting the various components (control units, pumping stations, meters, and solenoid valves) that will be placed under crossings must be inserted into conduits of adequate section according to the characteristics of the individual conductors, maintaining the separation between 220/24V cables and telephone and communication cables.
All conduits must be of the co-extruded corrugated type, red for 220/24V electrical lines and blue for telephone lines, and be equipped with inspection manholes placed at a distance to ensure their possible replacement. T
he inspection manholes, for all cables except those for solenoid valves, must not be placed at distances greater than 25/30 meters and must be located at every point of route variation. Any joint of the programmer's power cable must be made using watertight tube connectors and silicone resin and must be located in a manhole.
The break-section inspection manholes will be masonry, 30 x 30 cm, with a galvanized and painted iron cover, driveable. The conduits must be placed in the same trench as the supply pipes, parallel and immediately above them. All electrical cables must comply with the laws regulating their use.
The cable routes must be marked by a warning net to be installed about 20 centimeters above the upper limit of the respective conduits.
All connections must be made in compliance with current CEI standards, with the issuance of the related declaration of conformity of the system (DM 37/2008) by the company. The calculation of protections and the creation of the related electrical system diagram must be signed by a qualified professional before the start of electrical works.

At the end of the works, the Contractor must provide the electrical testing and the final updated system diagram, also drawn up by a qualified professional authorized to issue the self-certification of compliance with current electrical standards.

3.11. Electrical panels

The electrical panels must be positioned within the green area and must not serve any system other than the irrigation system.
The cabinets for housing the programmers must have the following dimensions: 687 x 630 x 238 mm, be made of impact-resistant material, and equipped with a lock.
The electrical panels must include a circuit breaker and a 10/16 A electrical outlet under a switch and must be housed in anti-vandal cabinets compliant with current standards.
The concrete base of the cabinet must provide for the passage of three conduits: one Ø 100 mm for the passage of cables for the solenoid valves and two Ø 50 mm, one for the power supply grounding and the other for communication cables.

3.12. Programmers

Depending on the size of the system and the number of solenoid valves, battery-operated or electric control units compatible with the irrigation management system, based on remote communication via fixed or GSM telephone line currently used by the "Settore parchi e giardini", can be used.
These programmers, complete with interface and modem, must be connected to a telephone line so that they can communicate with the control unit installed at the "Settore parchi e giardini", headquarters if the network is to be managed by the municipality.
These programmers, in addition to functioning remotely, i.e., controlled by the central unit software, must also be able to operate in local mode, autonomously, like a normal programmer, independent of the central connection and thus able to be used for manual opening or closing of the solenoid valves for maintenance reasons or for executing irrigation programs set directly on the programmers themselves.
In addition to general protection by a fuse of adequate amperage, the programmers will have an additional panel for active protection against overloads and/or voltage surges on all primary input circuits and secondary output circuits. Each programmer must be protected by a circuit breaker and have an independent grounding with a resistance not exceeding 10 Ohms. In case of power failure, a 9-volt lithium or similar battery will maintain the memories and must have a minimum duration of 5 years. The programmers must be housed inside cabinets equipped with a lock and positioned in the green area and out of the range of the sprinklers, without obstructing the normal use of the park. The cabinet should not be too visible to avoid possible vandalism on the control units if accessible from public space.

3.13. Grounding

Each programmer must be equipped with its own grounding, to be made using one or more steel or copper rods, connected by a bare copper wire of 16 mm², capable of ensuring a dispersion resistance not exceeding 10 Ohms.
All equipment, panels, and metal parts, where necessary and required by regulations, must be connected to a suitable grounding system.

3.14. Irrigation sprinklers

All irrigation sprinklers, both static and dynamic, must be installed on flexible joints to better withstand impacts and settlements. In any case, the installation of any type of sprinkler on a rigid extension inserted, either directly or indirectly, on the branch pipe will not be accepted. The sprinklers, hydraulically grouped into homogeneous sectors and divided according to the destinations and exposure of the areas concerned, must be arranged in such a way as to determine, for the same type, equal rainfall intensity.
Static - Static type sprinklers must have a body and head riser made of impact-resistant and corrosion-resistant plastic material, stainless steel spring for retraction at the end of irrigation, sand guard seal, anti-drain device, friction for adjusting the head jet orientation after installation, and a removable protection filter from the top of the riser.

Riser height from 10 to 30 cm approximately, depending on the type needed in the various areas to be irrigated; operating pressure 2.0-2.5 atm, dynamic at the base of each sprinkler. Possibility to adapt different heads with preset angles (90°-360°) or adjustable heads equipped with a break-up screw for range adjustment. The static sprinklers intended for irrigation above and below the canopy of shrub and ground cover areas must be equipped with a non-removable pressure-compensating valve to equalize pressure and reduce water leakage in case of theft or head breakage, without compromising the operation of other sprinklers in the sector. They must also have a self-cleaning, self-lubricating seal, non-removable with a stainless steel return spring. The static sprinklers in some shrub areas must ensure water distribution in separate jets, to achieve the best foliage penetration. The interchangeable heads, depending on the required irrigation angle, must have proportional water distribution.

Dynamic - Dynamic type sprinklers must have a body made of impact-resistant and corrosion-resistant plastic material. They must be turbine type, with water-lubricated gears, equipped with a self-cleaning seal and filter to retain impurities, stainless steel return spring, self-cleaning seal for water tightness during lifting, and cleaning of the riser during retraction. They will be equipped with an automatic anti-drain valve to prevent waterlogging of the soil near the lower sprinklers.

The variable sector models must be equipped with a mechanism for setting the angle, with memory of the same, unless a new intervention on the friction, with a working angle from 35° to 360°. The sprinklers must be equipped with a wide range of pressure-compensating heads, with variable performance of hydraulic characteristics (range, operating pressure, flow rate), to ensure uniform precipitation depending on the type of head, in relation to the set angle. They must have the possibility of adjusting the range and working angle, with flow always proportional to the angle. Riser height from 10 to 30 cm, dynamic operating pressure at the sprinkler from 2.5 to 5 atm, and range from 5 to 30 m depending on the various installed models. The dynamic sprinklers must provide for different rotation speeds, operation both in full circle and variable sectors with interchangeable nozzles at proportional flow and an anti-vandal system set to maintain the memory of the irrigation arc even in case of vandalism.

The installation of the sprinklers should preferably be done with an anti-vandal rotating joint so that it cannot be unscrewed from above or with a piece of PVC pipe of adequate diameter, to be inserted into the sprinkler body, positioning it so that it protrudes 1-2 cm above the sprinkler. All sprinklers must be positioned according to the project specifications. Any relocations must not exceed 60% of the sprinkler's diameter. They must be arranged to ensure adequate coverage over the entire surface.

3.15. Articulated Joint

The connection of the sprinklers to the pipe will be made with special joints of variable length according to the positioning needs of the sprinkler itself.

The joint will consist of two self-threading passage fittings at the ends, sized appropriately for the pipe and the sprinkler. The flexible PN 16 union pipe must be mounted to form a wide spiral to allow easy movement of the sprinkler and to avoid dangerous stresses on the threads.

3.16. Drip Line

For all newly planted trees, shrubs, ground covers, and flowers, an independent drip line must be provided.

The sub-irrigation will be with a 16/20 mm PE drip line, thick enough to withstand an operating pressure of up to 4 atm.

The sub-irrigation for trees will be done using self-compensating polyethylene dispersing pipes with drippers inserted at standard intervals.

To avoid nozzle clogging as much as possible, the drip line will be housed inside 3-meter-long drainage conduits, equipped with a T-joint, with a minimum diameter of 32 mm, corrugated externally, with at least 4 radial holes around the circumference.

The drip line for shrubs will be placed above the ground, under the mulch fabric and pine bark cover.

For shrub irrigation, the drip line installation requires variable spacing according to the planting pattern as indicated in the following scheme:

- 1 plant/m²: 1 m drip line
- 4 plants/m²: 2 m drip line

- 9 plants/m²: 3 m drip line

Along the supply lines, partialization taps, pressure regulators, and an adequate filtration system must be provided. To avoid sharp bends and kinks that could interrupt the water flow, the use of appropriate rigid fittings at critical points is required. Each solenoid valve serving the drip line will have a pressure reducer and a Y-filter, all housed in an inspectable manhole.

3.17. Auxiliary Network for the System

As a complement to the automatic irrigation system, if necessary, a network of water intake points (hydrants) must be provided to meet the small demands related to the cultivation operations of the green area and allow operators to draw limited volumes of water, automatically pressurizing the network only during normal working hours.
The hydrant and the draw-off key must be made of bronze, with a bayonet connection and a stainless steel spring.
The hydrants must be installed on an articulated joint with a galvanized steel terminal part fixed in place, at ground level, using a concrete base of such size as to ensure its immovability.
The positions of all hydrants must comply with the executive project indications and, in general, should not deviate from the pedestrian paths and must be easily accessible to operators. The hydrants will be placed as branches of the main pipe.
The quick-connect bronze draw-off keys must have a swiveling elbow with a hose connection at the top.

3.18. Route delimitation

During the implementation phase, a qualified technician from the Contractor will be responsible for marking the position of the equipment and materials with appropriate colored stakes to code the following materials:

- Dynamic sprinklers
- Static sprinklers
- Pipe routes
- Hydrants
- Automatic drains
- Drip line

The staking of the sprinklers must be done with a measuring tape, taking care to position them according to the Manufacturer's instructions, to ensure the best uniformity of water distribution. The pipes must comply with the project indications and be placed as much as possible along existing paths and walkways.

3.19. Irrigation start-up

The operations to be carried out when starting up the irrigation system are:

- Closing the drain taps of the collectors, opening the general supply hydrant, activating the water extraction pump, opening the gate valves and solenoid valves of the control groups;
- General inspection of the condition of the various components;
- Cleaning the solenoid valves, checking the electricity supply to the solenoid and cleaning it; cleaning the filter; checking the hydraulic tightness of the control groups; checking the correct water flow from the collectors to the solenoid valves and replacing any damaged parts;
- Checking the programmer's operation and fuse efficiency;
- Cleaning, greasing, and changing the oil of the pumps, checking their perfect operation, testing the operation of the main interception gate valves; bleeding air from the water pipes. Cleaning oxidized contacts;
- Activating the programmer by performing a test irrigation cycle for each sector;

- Checking the efficiency of the sprinklers, cleaning nozzles, cleaning the sprinkler filter, adjusting the spray length and working angle, and replacing the device if necessary;
- Checking the operation of the drippers and drip lines, replacing them if clogged;
- Verifying the operation of the automatic systems managed remotely by the management system used by the Parks and Gardens Department;
- At the system start-up, checking and verifying the electrical, telephone, and data transmission connections between the central unit and the peripheral units. Checking and possibly reprogramming the set parameters. Spare parts are excluded.

3.20. Irrigation system shutdown

The operations to be carried out when shutting down the irrigation system are:

- Closing the supply hydrants, opening the collector drain taps, deactivating the electric pumps, closing the solenoid valve gate valves, disconnecting the power supply, draining the water from the sprinkler bodies and pipes, emptying the water from the sector control valves, cleaning the sprinkler manholes;
- Putting the programmers on standby.

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Sitewide pipework and accessories
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

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1. INTRODUCTION

This specification details the requirements for sitewide pipework and accessories.

The type, size, and performance requirements must comply with the attached project documents. The installation must follow the details indicated in the Contract Documents, Drawings, and Specifications and must comply with the standards mentioned in the technical specifications.

2. GENERAL REQUIREMENTS

2.1. Excavations

Foundation excavations, in general, refer to those narrow and confined excavations required for the construction of walls or foundation pillars proper.

In all cases, excavations intended for the laying of pipelines, structures below ground level, ditches, and gutters will also be considered as foundation excavations.

The excavations will be carried out in accordance with the geometric profiles indicated in the project and/or as prescribed by the director of works.

The contractor is strictly prohibited, under penalty of demolition of the executed works, from laying pipelines, structures, or initiating masonry work before the director of works has inspected and approved the excavation levels.

During the execution of the excavations, the contractor must ensure that the edges are diligently shaped, the slopes achieve the inclination specified in the project, or as deemed necessary and prescribed by the director of works through specific directives. This is to prevent landslides, with the contractor being fully responsible for any damages to persons or works. Furthermore, the contractor shall bear the cost and responsibility of removing collapsed materials in the event of non-compliance with the directives provided for this purpose.

The contractor must execute material handling using appropriate equipment and sufficient labor to complete the excavations, as far as possible, to full section in each initiated segment.

If excavations are to be performed in the presence of water, and water accumulates within the excavations, the contractor must undertake water removal using methods deemed most suitable. The removal of groundwater will be under the care and responsibility of the contractor.

Upon completion of the foundation masonry or the construction of underground structures, the remaining empty excavation must be diligently filled and compacted by the contractor, at their expense, using materials specified in the project or, if unspecified, with the excavated material itself. This must be done up to the level of the original natural ground surface, unless otherwise specified in the project.

2.1.1. Trench excavations

In executing trench excavations, the contractor must adhere to the length of the sections to be excavated as prescribed by the director of works.

The excavation depth shall be calculated from the extrados level of the ballast to 10–15 cm below the external lower generatrix of the pipeline to be laid, depending on the pipe dimensions, to accommodate the bedding layer. The bottom width of the excavation shall be determined based on the pipe diameters, as detailed in Table 1.

The contractor is strictly prohibited, under penalty of demolition of the completed work, from laying pipelines, constructing structures, or initiating masonry work until the director of works has verified and approved the excavation levels.

The foundation planes of walls and structures shall generally be horizontal.

For pipeline installation, the contractor must, prior to commencing work, check and coordinate the altimetric levels of existing pipelines to which the new pipeline must connect. Consequently, the contractor is required to submit to the director of works a site plan and profile of the terrain, indicating the levels of the final connections, potential interferences with other structures, and additional or relocated planimetric and elevation benchmarks in cases where the existing ones are insufficient or could be damaged by machinery during the work. The excavation price shall include the cost of widening for the formation of lateral and bottom recesses at the joints, allowing for thorough inspection of the joints during leak testing.

Upon completing the construction of underground structures, any remaining empty excavation must be diligently filled and compacted by the contractor, at their expense, using the materials specified in the project, up to the terrain level prescribed in the project.

Excavations must be carried out with a base angle of 60° (slope ratio 2:3) or stepped, maintaining a maximum excavation height of 1.5 meters and a minimum step width of 60 cm. When necessary, solid shoring and bracing with sturdy frameworks must be implemented to protect workers from any risks and prevent material sliding during excavation, pipe installation, or masonry construction.

The contractor is responsible for any damages to the works, individuals, public, and private property arising from the absence or inadequacy of such shoring and bracing. The contractor must independently implement these safety measures and any other precautions deemed necessary, without refusing to comply with any instructions provided by the director of works in this regard.

If excavations are performed in the presence of water and water accumulates within the trenches, the contractor must ensure its removal using the most appropriate methods. The removal of groundwater shall be under the care and responsibility of the contractor.

2.1.2. Excavations near building

When works are carried out along roads adjacent to buildings or previously constructed structures, the excavations must be preceded by a thorough examination of the foundations of these buildings or structures. This examination should be complemented by surveys aimed at determining the nature, consistency, and depth of the foundations, particularly when it is presumed that trench excavation could pose a risk to the stability of the buildings.

In such situations, the contractor, in coordination with the director of works, must perform stability verification calculations under the most adverse conditions that may arise during the work. Additionally, the contractor must design any necessary protective measures, whether temporary or permanent, deemed appropriate to ensure the stability and safety of the affected structures.

2.1.3. Interference with public utilities

All expenses incurred by the contractor due to additional challenges arising from the presence of other underground utilities, even if not explicitly accounted for in the project's cost estimate, are considered to be included in the price for which the excavations are compensated.

2.1.4. Excavated materials

Without entitling the contractor to claim additional compensation beyond the price agreed for the excavation works, excavated materials deemed reusable by the director of works must be stored in separate piles according to their nature. These piles must be positioned in locations that do not interfere with or pose risks to other site activities.

2.1.5. Safety regulations

The contractor must minimize the space occupied by the works within traffic areas and implement the necessary measures to ensure the safe transit of vehicles and pedestrians, as well as the safety of the workforce.

In addition to all obligations and responsibilities related to accident prevention, the contractor is responsible for the strength and stability of any excavation support structures and is required to renew or reinforce any provisional works that are found to be weak.

At their sole expense, the contractor must enclose all excavations with sturdy barriers, constructed using planks free of protruding nails and splinters, to provide adequate protection.

2.2. Backfilling

The backfilling of excavations must be carried out to ensure that:

- Due to the nature of the material and compaction methods, no future settlements or irregular subsidence occur.
- The conduits and structures are not subjected to transverse forces, buoyancy, or displacement.
- An intimate bond is formed between the natural ground and the fill material, such that, through friction with the excavation walls, the load on the conduits is reduced.

The backfilling must be executed using mixed gravel material, either from quarries or recycled sources, unless the excavated material has suitable properties for recovery and reuse.
The removal of large foreign objects, such as rock fragments, boulders, large stones, pebbles, and similar materials, which could damage the structures during backfilling or, after compaction, cause load concentrations on the conduits, is entirely the responsibility of the contractor and is considered included in the excavation price.

The trench must be filled by spreading the material in successive layers of such thickness as to ensure adequate compaction without damaging the pipeline.
If the contractor exceeds the profiles established by the director of works, the excess volumes will not be accounted for. Furthermore, if instructed by the director of works, the contractor shall remove, at their own cost and expense, the excess deposited or transported volumes and take all necessary measures to avoid compromising the stability of the profiles approved by the director of works.

2.3. Pipe surround

The volume of concrete used for constructing the pipe surround will be calculated based on the table provided in the project documents. No additional compensation will be granted if the contractor increases the quantity of concrete used for the pipe surround.

2.4. Pipe bedding

The volume of sand used for the construction of the pipe bedding will be calculated based on the table provided in the project documents (10–15 cm depending on the pipe diameter). No additional compensation will be granted if the Contractor increases the quantity of sand used for the pipe bedding.

2.5. Pipeline marking

Before the backfilling is completed, a marking tape indicating the presence of the pipeline beneath must be laid.

The tape must be laid at a distance of 50 cm above the upper generatrix of the pipe for depths exceeding 110 cm. For shallower pipeline depths, the distance between the tape and the upper generatrix of the pipe must be agreed upon with the director of works to ensure that any subsequent excavation work can be promptly interrupted before damaging the pipeline.

2.6. Installation of pressure pipelines

The construction of pipelines must comply with the provisions of the D.M. 12/12/1985 on "Technical standards for pipelines" and the related Circular Circolare Min. LL.PP. 20/03/86, n. 27291.

As per project specifications and the director of works instructions, a bedding layer of sand must be prepared, ensuring the removal of unsuitable materials such as mud, peat, or other organic matter from the trench bottom. Additionally, all irregularities that could damage the pipes or their coatings must be eliminated.

The thickness of the bedding layer must follow the project specifications. After verifying the alignment of the pipes and completing the joints, the bedding will be followed by side fills, also using sand, on both sides of the pipeline.
Under no circumstances should the position of the pipes in the trench be adjusted using stones, bricks, or other discontinuous supports.
In the presence of groundwater, a drainage system must be installed, including a gravel or crushed stone bedding and a system to remove water from the trench bottom to ensure the pipeline's stability.

The installation of pipes, joints, and special fittings must strictly follow the manufacturer’s instructions for the respective materials used.

If installation operations are interrupted, the ends of the installed pipeline must be carefully sealed to prevent the ingress of foreign solid or liquid materials.

Pipes, equipment, and special fittings must be carefully lowered into the trench or shafts to avoid drops or impacts. They must be lowered as close as possible to their final installation points to minimize longitudinal movements along the trench.

All necessary precautions must be taken to prevent damage to the installed pipeline, including careful handling during operations and vigilance during work interruptions to prevent the falling of materials of any type or size that could damage the pipeline and equipment.

Pipes found to be damaged in a way that compromises their functionality must be discarded and, if already installed, replaced. If the damage is limited to the coating, it must be repaired, even completely, subject to evaluation by the director of works based on the extent of the damage.
Pipelines must be constructed using the maximum number of full-length pipes with standard commercial lengths to minimize the number of joints. The use of pipe segments is prohibited unless expressly authorized by the director of works.

Special fittings, equipment, and similar components must be installed with care and precision, respecting alignments and the integrity of the most delicate parts. Any flanges, nuts, and bolts must comply with UNI standards, be perfectly intact, clean, and protected with anti-rust grease.
The alignment of all special fittings and equipment with the pipeline must strictly adhere to horizontal or vertical planes unless otherwise directed by the director of works.

2.6.1. Installation of polyethylene Pipelines

In the installation of polyethylene pipes, welding must be carried out by specialized personnel holding certification in compliance with UNI 9737/97, issued by an authorized training institute or center.

The joining of polyethylene pipes and fittings must be performed in strict accordance with the UNI EN 12201-3/2013 standard.

Pipe joints must be executed while ensuring alignment of the colored coextrusion lines marked on the pipes.

2.6.2. Installation of steel pipelines

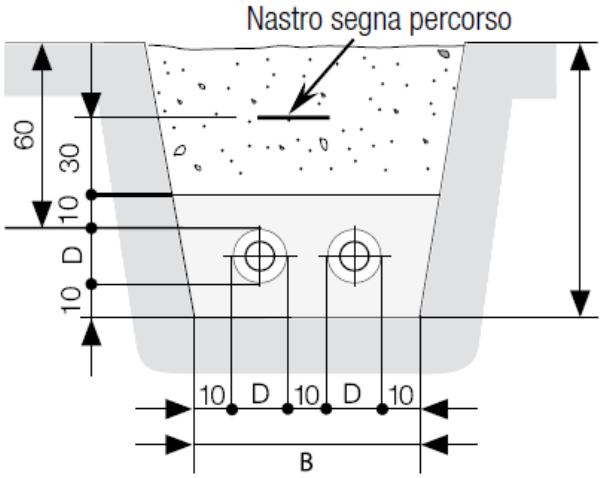
This section applies exclusively to steel pressure pipelines located in pumping stations.
In the installation of steel pipes, welding must be carried out by specialized personnel holding certification in compliance with the UNI EN ISO 9606-01:2013 standard, issued by an authorized training institute or center.
The director of works may request the removal of personnel whose qualifications are deemed insufficient or, despite holding officially recognized certifications, fail to demonstrate, during a practical test, the technical knowledge and skills required, at the sole discretion of the director of works. The recognition of the welder's suitability by the Site Supervisor does not exempt the contractor from responsibility for the successful execution of the welding and the corresponding obligations imposed on the contractor.
Upon request, the contractor must provide a report, possibly accompanied by drawings, specifying the dimensions of the weld beads, the number of passes to form the welds, the type and gauge of electrodes to be used for each pass, the corresponding electrical current, and the equipment and facilities proposed for use.
Only coated electrodes with filler metal that possesses characteristics similar and compatible with the base metal may be used. The type of electrodes must be approved by the director of works, who may also request preliminary testing.
Both before and after the installation of the pipelines, the condition and integrity of protective coatings must be verified, both visually and using an insulating coating analyzer capable of generating an impulse voltage adjustable based on the thickness of the insulation. The necessary equipment shall be supplied at the contractor's expense.
After welding operations, protective coatings must be carefully reconstructed to match the quality and thickness of the factory-applied coating along the rest of the pipeline.

2.6.3. Installation of pre-insulated cross-linked high-pressure polyethylene pipes

Open trench installation: The most common installation method involves creating a dedicated trench. A narrow trench can be excavated, with additional space only provided at connection points to facilitate easy working conditions.
Method with channel insertion: This method is used to lay pipes within disused channels, empty ducts previously installed, or plastic casing pipes that require rehabilitation.
Method with perforating coil: The installation method using a perforating coil avoids open trench excavation in areas where such operations are difficult (e.g., protected or restricted zones), thus reducing construction costs. This method allows the crossing of terrain beneath watercourses. In such cases, a protective sheath must be used.
Plowing Method: This procedure enables quick and efficient pipe installation with minimal effort. It is suitable for stone-free terrain or when a sand bed for the pipe installation is guaranteed.

Excavation works
The dimensions of the excavation for pipeline installation influence both the magnitude and distribution of the load exerted by the soil and traffic, thereby affecting the operability of the pipeline. The width of the trench base should be calculated based on the external diameter of the pipe and the potential need for a workable area during pipe installation.
For installations beneath traffic circulation routes, the work must comply with DIN 1072 standards, adhering to stress classes SLW 30 (corresponding to a total load of 300 kN) or SLW 60. For loads exceeding SLW 30 (e.g., SLW 60), a load-

distribution structure (e.g., slabs for load distribution) must be used in accordance with the RStO 75 directive. Workable areas as defined by DIN 4124 are required only at joint connections.
The height of the cover must range from a minimum of 60 cm to a maximum of 2.6 m. For covers exceeding this height, a static verification calculation must be performed.
The trench bed must be prepared to the specified width and depth, ensuring that the pipeline is supported along its entire length. The trench bed soil must remain undisturbed. Cohesive soil must be excavated to a depth where it becomes more compact and replaced with non-cohesive soil or other specific pipe supports. Disturbed and/or non-cohesive soil must be re-compacted.
In the area of the pipe passage, only sand with a grain size of 0/4 should be used, and the backfilling must be performed manually, layer by layer.



Installlation distances between supply pipelines
The installation must be carried out while maintaining minimum distances from other supply pipelines (refer to Table 22). Potable water pipelines located near district heating pipes must be protected against potential heat effects. If it is not possible to maintain the predefined distances, appropriate insulation measures must be implemented.

Tipo di condotto di alimentazione	Condotti paralleli <5 m condotti incrociati	Condotti paralleli >5 m
Cavo di segnalazione e misurazione da 1-kV *	0,3 m	0,3 m
Cavo da 10-kV o da 30-kV *	0,6 m	0,7 m
Più cavi da 30-kV oppure cavo da oltre 60 kV *	1,0 m	1,5 m
Condotti per gas e acqua	0,2 m	0,4 m

Pipe securing in specific installation conditions
Marshy and alluvial soils
When installing pipelines in marshy and/or coastal alluvial soils, near groundwater tables, or beneath trafficked areas, any obstacles that could affect the foundations supporting the pipes must be removed to a sufficient depth below the pipes. If the excavation bed does not provide adequate load-bearing capacity, contains high water content, or consists of layers of soil with varying load-bearing properties, the pipeline must be protected using appropriate construction techniques, such as the application of a layer of tiles.
Descending sections
In descending sections, it is essential to prevent the supporting layer from sliding by applying adequate transverse reinforcements and, if necessary, implementing drainage systems.

2.6.4. Testing

The pipeline shall undergo a hydraulic pressure test, conducted in successive sections, at a pressure equal to 1.5 times the operating pressure. The duration and procedures will be as specified in the project or as directed by the director of works and must comply with the provisions of Article 3.10 of the Ministerial Decree of Public Works dated 12/12/1985, as amended.
The test, conducted with exposed joints, will be considered successful based on the results recorded by an officially calibrated pressure gauge chart recorder and through the simultaneous verification of the tightness of each individual joint. This same test shall then be repeated after the complete backfilling of the pipelines, based on the results from the pressure gauge chart.
The exposed joint test shall last 8 hours, while the test conducted after backfilling shall last 4 hours. The test pressure must be gradually achieved at a rate not exceeding one atmosphere per minute.
Reports, discs with pressure gauge charts, and any related illustrative drawings concerning the tests must be submitted to the Testing Supervisor, who reserves the right to require the tests to be repeated.
The contractor shall, at their own expense, provide the required water, any necessary blind flanges, pumps, pressure gauge recorders with official calibration certificates, connections, and any other equipment required for the tests. The water used must meet potability standards, with appropriate documentation provided. The Site Supervisor, at their sole discretion, may prohibit the contractor from using water deemed unsuitable.
A specific report shall be prepared for the pressure tests, regardless of the outcome.
Following successful tests, both the pipelines and tanks or reservoirs must remain filled with water, at the contractor's care and expense, until final testing is completed.

2.7. Installation of gravity pipelines

Pipes must be installed from downstream to upstream, with the bell socket oriented opposite to the flow direction. Care must be taken to prevent debris or foreign materials from entering the interior, and to avoid damage to the internal surface of the pipe, pipe ends, protective coatings, or sealing gaskets.

2.7.1. Testing

The testing must be conducted in compliance with the ENV 1401-3 standard for plastic resin pipelines.

3. MATERIAL FEATURES AND PIPING INSTALLATIONS

3.1. PVC pipelines

Polyvinyl chloride (PVC) pipes for sewage systems must comply with the provisions of UNI EN 1401 regarding types, dimensions, and characteristics, except where otherwise specified in these regulations. The standard specifies three types (or series) of pipes: SN2, SN4, and SN8, corresponding to three different wall thickness categories.

The series to be used is SN8.

The contractor must inform the director of works, prior to procurement, of the manufacturers from which the materials will be sourced, along with their respective specifications.
Pipes and fittings must bear the IIP conformity mark, owned by the Italian National Standards Organization (UNI) and managed by the Italian Institute of Plastics (IIP).
The director of works reserves the right to perform or have performed any tests deemed necessary to approve the supply, in compliance with the aforementioned standard.

3.1.1. Marking

Pipes and fittings must be marked with the following information:
- Manufacturer identification

- The certification body for the product, accredited by Sincert (e.g., IIP or equivalent)
- Reference to the EN 1401 standard
- Material
- Nominal size (DN)
- Nominal angle (on fittings)
- Production date

The manufacturer of the pipes and fittings must be certified to the UNI-EN-ISO 9001:2008 standard; otherwise, the material will not be accepted.

3.1.2. Transportation and stacking of pipes

During transportation, pipes must be supported along their entire length to avoid damage to the ends caused by vibrations. Impacts, bending, excessive overhangs, and contact with sharp or pointed objects must be avoided.
Load fastening straps may be made of hemp or nylon ropes or bands. If steel cables are used, the pipes must be protected at the points of contact.
Loading and unloading operations must be carried out with care. Pipes must not be thrown or dragged but must be carefully lifted and placed.
Pipes must be stacked on a flat surface, with a maximum stacking height of 1.50 meters.
If the pipes are not used for an extended period, they must be protected from direct sunlight.

3.1.3. Jointing systems

The connection between PVC pipes shall be made using bell joints or axial sliding couplings with sealing ensured by elastomeric gaskets.

The pipe ends must be properly beveled, and the joining surfaces thoroughly cleaned. The inner surface of the gasket must be lubricated with a suitable lubricant, after which the pipe shall be inserted into the bell or coupling, ensuring that at least 1 cm remains between the pipe end and the stopping point.

3.2. HDPE pipelines

3.2.1. Specifications for material acceptance: gravity HDPE

The supply of high-density polyethylene (HDPE) piping for underground non-pressurized drainage systems must feature a structured wall profile, corrugated with a double-wall type (B), smooth on the inside and corrugated on the outside, and black in color.

Connections between elements must be made using dedicated bell or coupling joints equipped with appropriate EPDM sealing gaskets. The pipe and joint system must carry a product conformity mark compliant with UNI EN 13476-3, issued by a third-party certification body accredited according to UNI CEI EN ISO/IEC 17065. Pipes must also be certified for abrasion resistance according to DIN EN 295-3 testing standards.

The marking must include the product quality mark, along with all other elements required by the reference standard. The pipe manufacturer must operate a certified Quality Management System in compliance with UNI EN ISO 9001 and an Environmental Management System in compliance with UNI EN ISO 14001. Both certifications must be validated by an accredited third-party body, and the manufacturer must be duly registered with the mandatory PolieCo Consortium (Legislative Decree 152/2006 – Art. 234).

Corrugated PE pipes with outer diameter (DN/OD) ranging from 250 mm to 630 mm, SN 8, and corrugated PE pipes with inner diameter (DN/ID) ranging from 800 mm to 1000 mm, SN 8, are to be supplied as specified in the attached table.

DN/OD	d_m	DN/ID	d_e
125	105	-	-
160	137	-	-
200	172	-	-
250	218	-	-
-	-	250	284
315	272	-	-
-	-	300	350
400	347	-	-
-	-	400	468
500	433	-	-
-	-	500	565
630	535	-	-
-	-	600	701
800	678	-	-
-	-	800	935
1000	852	-	-
-	-	1000	1200
1200	1030	-	-

3.2.2. Specifications for material acceptance: pressurized HDPE

The stormwater drainage system downstream of the pumping station will utilize high-density polyethylene (HDPE) pipes for underground pressurized sewer and drainage systems.
The supply and installation of high-density polyethylene pipes (PE100), solid-wall Type 1, are intended for underground and above-ground applications, including raw water transportation before treatment, pressurized sewer and drainage systems, vacuum sewer systems, and water for other uses. The pipes must be black or black with coextruded brown stripes, pigmented and stabilized in granules at the source, with a nominal outer diameter of DN…..mm, SDR …. (PN …).
The pipes must fully comply with the UNI EN 12201-2 standard and bear a conformity mark issued by a third-party certification body accredited in accordance with UNI CEI EN ISO/IEC 17065/2012 and UNI CEI EN ISO/IEC 17020/2012 (product conformity certification).

The pipes must be manufactured by a company equipped with the following management systems:

- QUALITY in compliance with UNI EN ISO 9001:2008
- ENVIRONMENT in compliance with UNI EN ISO 14001:2004
- SAFETY in compliance with BS OHSAS 18001:2007
- All certifications must be validated by an accredited third-party organization.

The pipes must be SDR 17 PN10.
The internal and external surfaces of the pipes and fittings must be smooth, clean, and free of cavities, bubbles, impurities, or any other surface irregularities that could affect compliance with the standard.
The pipe ends must be cleanly cut and perpendicular to the pipe axis. The edges of spiral-wound pipes, which may become sharp after cutting, must be rounded.

3.2.3. Joining of pipes and fittings

The connection between elements must be made using bell or coupling joints equipped with appropriate elastomeric EPDM sealing gaskets compliant with the EN 681-1 standard. These gaskets must be positioned in the first groove of the corrugation (between the first two ribs) on the pipe end to be inserted into the bell, or, where applicable, in the dedicated seat located on the crest of the first corrugation ring.

The elastomeric ring gaskets provided with each bell or coupling must ensure joint sealing and long-term consistency of the required characteristics.

The manufacturing compounds used must, in all cases, be free from regenerated materials.

The gaskets must bear the markings required by the standard in an indelible manner. For acceptance of the supplied gaskets, accompanied by the aforementioned certificate, a visual inspection is performed to verify their general appearance and finish. The gaskets must exhibit material uniformity, absence of air bubbles, blisters, pinholes, and cuts. The surface must be smooth, perfectly molded, and free from defects, impurities, or foreign particles.

Joints must be executed following these instructions, applicable to both pipes and special fittings:
- Thoroughly clean the parts to be joined, ensuring they are intact.
- Temporarily remove the gasket if it is already in place.
- Correctly insert the elastomeric sealing gasket into the first groove of the corrugation or the dedicated seat, where applicable.
- Lubricate the outer surface of the gasket and the inner surface of the bell or coupling with an appropriate sliding substance (e.g., soap, soapy water). Avoid using mineral oils or greases, which could damage the gasket.
- Insert the "male" end of the pipe into the bell until it stops. The success of this operation depends on the precise alignment of the pipes and the proper lubrication.

3.2.4. Marking

High-Density Polyethylene Pipes (HDPE) must bear the following markings:
- Reference standard
- Manufacturer's mark
- Material identification (PEHD)
- Indication of the application area
- Pipe series
- External diameter and wall thickness
- Indication of the production period
- Quality mark

High-Density Polyethylene Fittings (HDPE) must bear the following markings:
- Reference standard
- Manufacturer's mark
- Material identification (PEHD)
- Indication of the application area (B/BD)
- Diameter and nominal angle
- Indication of the production period
- Quality mark

3.2.5. Transportation and storage

During transportation, pipes must be stacked in an orderly and rational manner, ensuring they are supported along their entire length and handled carefully during loading and unloading operations to avoid violent impacts, abrasions, or deformations.

On-site, pipes and fittings must be handled with equal care to prevent any potential alteration or damage to the materials.

Pipes should be stored in a protected environment (shielded from weather and direct sunlight) and placed on flat, uniform surfaces, avoiding stacks higher than 1.70 meters.

3.2.6. Underground installations

The bedding material must be quarry sand free of pebbles, sharp stones, rocks, clay clumps, loam, organic substances, or frozen soil.
The pipes must be capped with concrete of a thickness appropriate to the pipe size.

Backfilling must be performed using dry material sourced from quarries or inert recovery plants, compacted in layers no thicker than 30 cm.

3.3. Pre-insulated cross-linked high-pressure polyethylene pipes

Pre-insulated pipes for district heating and cooling systems consist of coextruded, impermeable components bonded together along their entire length. They are composed of one or two high-pressure cross-linked polyethylene (PE-Xa) pipes, compliant with DIN 16892/93, SDR 11, equipped with an oxygen barrier according to DIN 4726, or SDR 7.4 for applications involving potable water, with DVGW approval.
The thermal insulation is made of polyurethane entirely free of chlorofluorocarbons (neither fully nor partially halogenated or non-halogenated) and features a protective PE-LLD (linear low-density polyethylene) outer layer.

characteristics

- No expansion within the trench due to the construction structure
- Maximum installation speed
- Reduced bending radii
- Excellent thermal insulation properties

Connections made with couplings capable of ensuring sealing and insulation equivalent to the main pipe section

Thermal Insulation Characteristics

- (Reagent: Propane)

Conduttività termica	≤ 0,0255 W/mK secondo EN 253
GWP (potenziale di surriscaldamento globale dovuto a effetto serra)	0,5
ODP (potenziale di assottigliamento dell'ozono)	0
Densità	≥ 65 kg/m³
Sollecitazione di pressione	0,2 MPa
Tensione di compressione	≤ 5 % secondo la norma EN 253
Resistenza prolungata alle temperature elevate	130 °C
Resistenza al taglio assiale del tubo (EN 253)	≥ 90 kPa

External Coating Characteristics: Low-density polyethylene (LDPE)

Conduttività termica	0,33 W/mK
Temperatura di fusione dei cristalliti	122 °C
Densità	0,92 g/cm^3
Modulo di elasticità	325 N/mm^2
Classe di reazione al fuoco (DIN 4102)	B2 (infiammabilità normale)

The installation of pipelines, whether through open trenching, perforating coil, channel insertion, or plowing, must be marked using a route marker tape.
In the area where the pipes are installed, only 0/4 sand may be used, and backfilling must be done manually, layer by layer.
If the trench bed does not provide sufficient load-bearing capacity, contains high water content, or consists of soil layers with varying load-bearing properties, the pipeline must be protected using appropriate construction techniques, such as the application of a layer of tiles.
Installation must be carried out while respecting the minimum bending radii. The following table provides the minimum bending radius as a function of pipe diameter at a coating pipe temperature of 10 °C.

76 mm	0,7 m
91 mm	0,8 m
111 mm	0,9 m
126 mm	1,0 m
142 mm	1,1 m
162 mm	1,2 m
182 mm	1,4 m

4. ACCESSORIES

4.1. Roadside gutters

Prefabricated elements made of vibrated concrete with an industrial finish, designed for use in areas subject to vehicular traffic to channel and collect stormwater ("CMC").

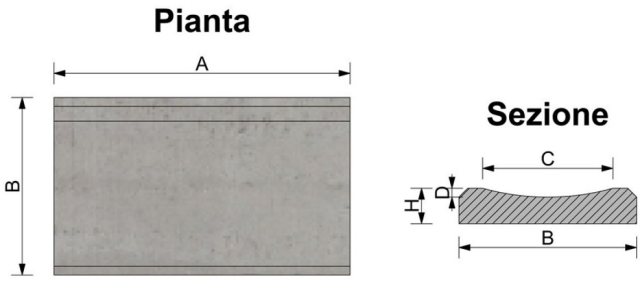
The elements are produced with a double slope toward the inner side.

Roadside gutters are manufactured using technologies that enable the production of highly compact, impermeable concrete with high durability, as prescribed by the UNI EN 206 and UNI EN 11104 standards.

Depending on internal and environmental temperatures, high-strength cements of class CEM 42.5R or CEM 52.5R are used, appropriately dosed and compliant with UNI EN 197-1.

A low workability consistency class (S1/S2) is adopted, and with the aid of additives compliant with UNI EN 934-2, water/cement ratios below 0.5 are achieved. The mixing water complies with UNI EN 1008.

The selected aggregates, CE-marked in accordance with UNI EN 12620 and 8520-2, are free from harmful or potentially alkali-reactive minerals as per UNI EN 932-3 and UNI 8520-2. The aggregates are divided into three particle size classes, with a maximum aggregate diameter of less than 1/4 of the thickness of the element.
The elements are produced and monitored at various stages of the production process in compliance with UNI EN 1340 and are provided with the corresponding CE Declaration of Performance.



4.2. Manholes

All pipe connections to the ground, as well as changes in diameter and direction, must occur within manholes.

4.2.1. Inspection manholes

Inspection, crossing, drop, flushing, maneuvering, venting, discharge, and similar manholes must be constructed in accordance with the project drawings.
For structures built on-site, ladder steps must be securely fixed, positioned perfectly vertically, aligned, and centered with the opening of the manhole cover above. Care must be taken not to damage the corrosion protection of the steps or the walls of the manhole, as specified.

Prefabricated inspection or junction manholes for sewer systems, made of vibro-compressed concrete, must withstand soil pressure and road traffic loads. Each component must use high sulfate-resistant cement, and the joints for connections, fittings, and extension pipes must be watertight. Unless otherwise specified, sealing must be ensured by synthetic rubber gaskets with a cross-sectional area of at least 10 cm², a hardness of 40 ± 5° IHRD, and compliance with UNI EN 681-1/97, DIN 4060, ISO 4633, and pr EN 681.1 standards, incorporated into the joint during prefabrication.

Access ladder steps are required for manholes with a free internal height greater than 1000 mm and must be installed in pre-drilled holes with a vertical spacing of 250 mm. The steps must comply with DIN 19555 standards.

Dimensional tolerances, controlled at the production facility and related to the circularity of joints, fittings, and connections, must be between 1% and 2% of the nominal dimensions. The manholes must be completely watertight and compliant with the requirements set forth in Annex 4 of the "Criteria, methodologies, and general technical standards" referenced in Article 2, letters B), D), and E), of Law No. 319 of May 10, 1976, concerning water protection regulations.

Cover slabs will typically be prefabricated and designed, reinforced, and constructed according to project specifications and the expected loads based on their location.

Manholes must be prefabricated from vibro-compressed concrete, consisting of a base element, extension elements, and a cover with a square drive-over slab, Class D400, featuring a circular "manhole opening."

Manholes must have a bottom and internal dimensions of at least 100x100 cm or 120x120 cm, with notches on the sides for lateral pipe connections. The manholes must be properly sealed and waterproofed to prevent liquid leakage or groundwater infiltration.

Manhole catch basins, with similar characteristics to inspection manholes, must have internal dimensions of 50x50 cm.
Inside the manholes, for future inspection and maintenance, marine-style ladder steps must be installed. These steps must be made of stainless steel coated with polypropylene.

For manholes located in areas designated as Truck Filling Stations, appropriate internal waterproofing must be provided to prevent the leakage of hydrocarbons and urea into the environment. Similarly, a perfect seal must be ensured between the pipes and the manholes.

4.3. Sampling manhole

Pozzetto in calcestruzzo gettato in opera o prefabbricato dotato di una sola entrata e una sola uscita con dislivello tra tubazione in ingresso e tubazione in uscita pari ad almeno un DN, fondo posto a più di 50 cm dalla tubazione di uscita per permettere il prelievo delle acque.

4.4. Leaf filter manhole

A manhole constructed on-site or prefabricated in concrete, equipped with a polypropylene filter basket that includes a stainless-steel handle for easy extraction.

4.5. Inspection manhole for branch siphon

A manhole for connection to the public network as specified by the utility provider’s guidelines and specifications.

4.6. Closure and capping devices for manholes

The closure and capping devices (manhole covers and grates) must comply with the material, performance, and marking requirements set forth by UNI EN 124/95. The manufacturer’s logo must occupy no more than 2% of the cover's surface and must not include personal names, geographic references to the producer, or overtly promotional messages.
Once installed, the upper surface of the device must be perfectly level with the finished road surface.

Inspection manhole covers, installed in drivable areas, must be made of spheroidal graphite cast iron ("manhole opening"), compliant with UNI EN 124, Class D 400 (breaking load of 40 tons). These covers must have an internal diameter of ø600 mm, embossed with the following markings: reference standard (UNI EN 124), resistance class (D 400), manufacturer's logo, and the certification body's mark.

Rainwater inlet manholes connected to the underground network must be closed with galvanized, welded steel grates suitable for horizontal and drivable use (Class D 400). The grates must have a mesh size of 25x25 mm and a minimum thickness of 50 mm. The metallic grate, which must be openable for inspection, will rest on an inverted "T"-shaped galvanized, welded steel frame with sectional dimensions of 70x50 mm. The frame will be fixed to the top of the manhole extension using an Rck 250 concrete collar with a minimum cross-section of 10x10 cm.

Flat grates for catch basins must be made of spheroidal graphite cast iron, compliant with UNI EN 124, Class D 400, with internal dimensions of 500x500 mm. The grates must feature wide-flow slots and be embossed with the following markings: reference standard (UNI EN 124), resistance class (D 400), manufacturer's logo, and certification body's mark. They must also be equipped with a siphon beneath the grate, made of polypropylene, of appropriate dimensions.

Grates for catch basins positioned along roadside gutters must be concave, compliant with EN 124-2:2015, Class D 400, and made of ductile cast iron (EN 1083 GJS 500/7). The grates must be coated with black bituminous paint and have external dimensions of 500x500 mm. The cover/frame locking mechanism must use elastic bars in spheroidal graphite cast iron, with a secure cover/frame connection compliant with EN 124:2015.

4.7. Channels with grates

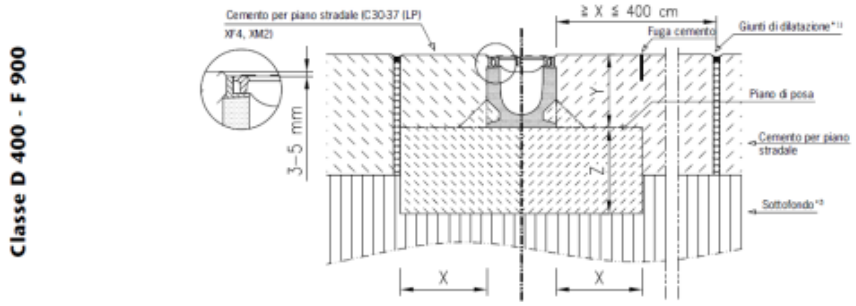
Polymer concrete channel ACO DRAIN Series S with preformed drainage outlets and ductile cast iron grates (GJS) for the following nominal widths: 100, 150, 200, 300 mm. Load Class D400 according to UNI EN 1433, featuring an 8-bolt steel fastening system for the grates and an integrated edge cover frame in ductile cast iron (GJS) with a thickness of 6 mm.

- Channel Gr1 (entry): S 150 10.0, L = 150 mm, H = 245 mm
- Channel Gr2 (base of loading bay): S 150 0.0, L = 150 mm, H = 195 mm
- Channel Gr2' (top of loading bay): S 150 0.0, L = 150 mm, H = 195 mm
- Channel Gr3 (all yards): S 300 50.0, L = 300 mm, H = 620 mm
- Channel Gr4 (south yard upstream of the pumping station): S 100 0.0, L = 100 mm, H = 112 mm

For installation, refer to the manufacturer's installation instructions

ACO Drain® S 100 - S 500

Pavimentazione in calcestruzzo



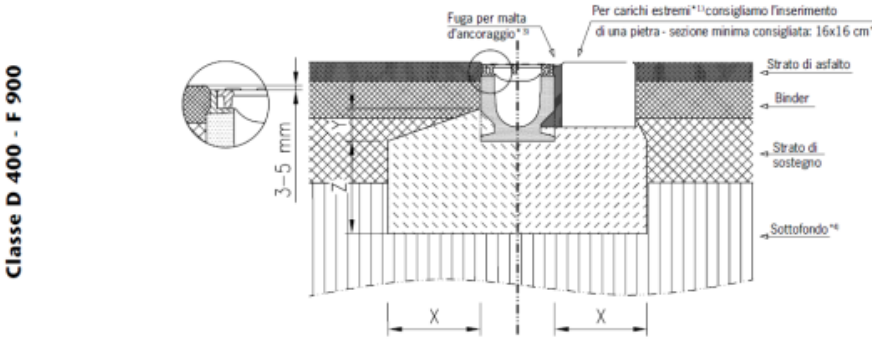
*In assenza di pietre 16x16 si può proseguire con il calcestruzzo di rinfianco fino al piano della strada

Classe di carico	UNI EN 1433	A 15	B 125	C 250	D 400	E 600	F 900
Qualità minima del calcestruzzo	UNI EN 206-1				≥ C25/30	≥ C25/30	Dati su richesta
Classe di esposizione del calcestruzzo	UNI EN 206-1				(XO)	(XO)	
Dimensioni delle fondazioni	[cm] rinfianco x				≥ 20	≥ 20	
	[cm] rinfianco Y				Altezza dell'elemento canale		
	[cm] magrone z				≥ 20	≥ 20	

*1) Vedi anche "Indicazioni particolari"
*2) Forma e spessore della parte sottostante il magrone come da progetto

ACO Drain® S 100 - S 500

Pavimentazione in asfalto



*In assenza di pietre 16x16 si può proseguire con il calcestruzzo di rinfianco fino al piano della strada

Classe di carico	UNI EN 1433	A 15	B 125	C 250	D 400	E 600	F 900
Qualità minima del calcestruzzo	UNI EN 206-1				≥ C25/30	≥ C25/30	Dati su richiesta
Classe di esposizione del calcestruzzo	UNI EN 206-1				(XO)	(XO)	
Dimensioni delle fondazioni	[cm] rinfianco x				≥ 20	≥ 20	
	[cm] rinfianco Y*2)				Estremità superiore delle scanalature di ancoraggio		
	[cm] magrone z				≥ 20	≥ 20	

*1) Vedi anche "Indicazioni particolari"
*2) Vedi anche "Indicazioni particolari"
*3) Vedi anche "Indicazioni pratiche"
*4) Forma e spessore della parte sottostante il magrone come da progetto.

4.8. Sand separator

STATIC SAND SEPARATOR model GAZEBO, prefabricated monoblock in reinforced concrete (RC), designed for underground installation, constructed with self-compacting concrete (SCC) made with PORTLAND CEMENT compliant with UNI EN 197-1, incorporating Type I mineral additives (ventilated calcium carbonate filler) and aggregates compliant with UNI EN 12620. It

has a compressive strength of C50/60 (Rck ≥ 600 Kg/cm²) and exposure classes XC4 (corrosion resistance to carbonation), XS2/XD2 (corrosion resistance to chlorides), XF1 (resistance to freeze/thaw cycles), and XA2 (resistance to chemically aggressive environments) in accordance with UNI EN 206-1. It is equipped with high-adherence internal steel reinforcements and factory-controlled B450C welded steel mesh, fully compliant with D.M. 17.01.2018, and features internal and external surfaces with a smooth, exposed finish, eliminating porosity and gravel nests.
The separator is complete with stainless steel (AISI 304) flow deflectors positioned near the water inlet and outlet pipes, optional reinforced concrete partition plates for creating internal treatment chambers, and hydraulic-sealed sleeves integrated into the tank walls for the connection of PVC inlet and outlet pipes.

The sand separators must also be equipped with automatic shut-off valves, an automatic maximum sludge level detection system, pedestrian or drivable covers, and spheroidal cast iron manhole covers.

Heavy Traffic DRIVABLE COVER (Category 1 road loads), prefabricated monoblock in reinforced concrete (RC), constructed with self-compacting concrete (SCC) made with PORTLAND CEMENT compliant with UNI EN 197-1, incorporating Type I mineral additives (ventilated calcium carbonate filler) and aggregates compliant with UNI EN 12620. It has a compressive strength of C50/60 (Rck ≥ 600 Kg/cm²) and exposure classes XC4 (corrosion resistance to carbonation), XS2/XD2 (corrosion resistance to chlorides), XF1 (resistance to freeze/thaw cycles), and XA2 (resistance to chemically aggressive environments) in accordance with UNI EN 206-1. It is equipped with high-adherence internal steel reinforcements and factory-controlled B450C welded steel mesh, fully compliant with D.M. 17.01.2018, and features internal and external surfaces with a smooth, exposed finish, eliminating porosity and gravel nests.
The cover is complete with D400 spheroidal cast iron manhole covers.

Operation
Static sand separators allow for the sedimentation of suspended particles (e.g., sand, soil traces) through gravitational effects. Particles with a specific weight different from that of water settle at the bottom of the structure.

4.9. Oil separator

A treatment system for runoff wastewater from impermeable surfaces contaminated with hydrocarbons, mineral oils, and heavy sediments, designed for parking lots, yards, workshops, and garages. It is constructed as a corrugated monoblock polyethylene (PE) unit, manufactured in an ISO 9001:2008 certified facility. The system complies with Legislative Decree No. 152 of 2006 for the discharge of treated effluent into surface water bodies and is designed and built according to UNI EN 858-1 for underground installation. The oil separator is equipped with an internal PVC or PE manifold (depending on the model), which directs the flow at the design capacity to the coalescence filter for filtration and automatically bypasses excess flow directly to the outlet. It includes a coalescence filter made of polyurethane foam housed in a removable stainless-steel basket, for separating suspended hydrocarbon and mineral oil droplets, complete with an automatic shut-off device. The separator also features a biogas vent, polypropylene (PP) manhole covers for inspections, maintenance, and cleaning, screw-on extensions for inspection points, and an alarm kit. The oil separator must be installed downstream of an appropriate sand separation system.

Operation
Oils and fats are present in many industrial wastewater streams, and their removal is necessary before discharge due to their negative environmental effects and as a preliminary treatment upstream of any purification phase to avoid inhibiting biological processes.
In the case of gas stations, workshops, and parking areas, oils and fats are of mineral origin and non-biodegradable, making their discharge into sewers, watercourses, or underground dispersion even more harmful—not only because of the risks of clogging but also because they cannot be degraded by the environment.
Oil separators with a coalescence filter ensure high removal efficiency for light substances. The system uses a polyurethane foam support enclosed in a stainless steel cage, where oil and hydrocarbon particles aggregate. Once the particles reach sufficient size, they separate from the wastewater by gravity. This treatment is recommended when particularly strict limits

on mineral oil and hydrocarbon concentrations in the discharge apply. It is advised to install a sand separator upstream of the oil separator to prevent solid substances from clogging the filter mesh.
The oil separator is equipped with an internal bypass manifold that activates automatically when the inflow rate exceeds the design capacity. The excess flow is directed straight to the outlet, preventing the coalescence filter from being overloaded.

Sizing and regulations

Oil separators with a coalescence filter are constructed and sized in compliance with the UNI EN 858-1 standard and are classified as Class I under the same. The sizing of oil separators is based on the definition of nominal flow rate, which is the maximum flow rate treatable according to project specifications. This value is determined to ensure an adequate retention time for the treated wastewater and is based on performance tests conducted with mixtures of water and diesel fuel.
The sizing must account for the type and flow rate of the substances to be treated, considering the volume of rainwater that may reach the system, the density of the light liquid, and the presence of substances that could impede separation, such as detergents. The design flow rate is calculated for light liquids with a density of less than 0.85 g/cm³ (e.g., diesel, gasoline), in the absence of detergents, and for surface runoff water only.
When properly maintained, the system ensures the treatment of wastewater in compliance with the requirements of Legislative Decree No. 152 of 03/04/2006, Part 3.
The following table summarizes the design data used for sizing coalescence oil separators:
Retention time: 15 minutes (at the treated flow rate)
Density of light liquids: < 0.85 g/cm³
Treated flow rate to maximum flow rate ratio: 20%

Use and maintenance

An excessive accumulation of floating material on the surface reduces the available volume for separation. This risk is exacerbated by significant inputs of settleable substances that accumulate at the bottom of the system. To prevent the release of solids and mineral oils that could compromise the quality of the discharged effluent, it is advisable to conduct regular inspections and remove accumulated pollutants. The oil separator is equipped with an automatic floating shut-off device, which closes the treatment section when the accumulated oil exceeds acceptable levels, preventing its release into the effluent.
Important: The shut-off device is a safety mechanism only; maintenance and cleaning must always be performed before it activates and closes the treatment section.
In general, maintenance operations will need to be more frequent if the system is servicing workshops, oil storage areas, or gas stations. For coalescence oil separators, in addition to routine emptying performed by specialized personnel, it is recommended to remove the polyurethane foam support and thoroughly clean it upstream of the system.

WHAT TO DO	WHEN	HOW TO DO IT
Inspection of the oil separator with coalescence filter	Every 1–2 months	Open the inspection caps and check the level of sediment and floating material. Ensure that the floating shut-off device is not blocked and moves freely within the filter.
Cleaning of the coalescence filter	Every 1–2 months	Remove the stainless steel cage containing the filter and clean it with a jet of water upstream of the system.

Removal of floating material, bottom sediments, and cleaning of inlet and outlet pipes	Every 6–12 months	Contact a specialized vacuum truck service company.

Instructions of installation
For installation, refer to the manufacturer's technical data sheet.

4.10. Shut-off valves for accidental spillage of diesel/urea/glycol

Ball valve suitable for use with hydrocarbons, natural gas, air, oils, and greases.

The valves are equipped with an electric actuator (220VAC) with open/close limit switches to indicate status. In the event of a servo motor failure, the valve remains in position (no automatic spring return), and the servo motor must include a manual disengagement option for manual closure.

The valves must feature elastomeric sealing made of Viton, a fluorinated elastomer that provides excellent chemical and thermal resistance, making it suitable for applications with hydrocarbons.

Technical Specifications:
- Body: Spheroidal cast iron
- Sealing sleeve
- Flanging: PN10
- Operating temperature: -20°C to +60°C

4.11. Sealing of pipe crossings on reinforced concrete structures

4.11.1. Sealing for core drilling

The sealing must be performed using a high-performance hydro-expanding mastic made of synthetic rubber and hydrophilic polymers, such as "Volteco AKTI-VO 201."
To apply the mastic, a recess of at least 8 cm in depth must be made along the entire circumference of the pipe penetration hole.
The sealing and restoration of the recess must be carried out using a waterproof hydraulic mortar suitable for use in wet conditions.

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MECHANICAL SYSTEMS

PROJECT SPECIFICATION
Noise and Vibration Control
Construction of new Data Centre
Via Galileo Galilei, SNC 20052 – Vignate (MI)

RIBA 3

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1. CONTRACTOR'S RESPONSIBILITIES

The vendor shall ensure and demonstrate that suitable environmental protection is provided to all components appropriate to maintain a product operating
The contractor shall be responsible for the development and installation of all necessary vibration and noise absorption materials and equipment to achieve the specified noise levels, both within the building and its surroundings.
The contractor shall be responsible for ascertaining the exact requirements to accord with his installation working drawings and for the provisions of required equipment and materials.
No addition to the Contract Sum will be allowed as a result of the contractor having to amend drawings, installation details, or for any cause or reason to achieve the required noise and vibration employer's requirements.
All information, including specialist calculations, drawings, etc., regarding sound levels of the equipment together with proposals for eliminating vibration and noise transmittance shall be submitted to the Engineer for approval prior to ordering the equipment.
The maintenance of the noise criteria shall be achieved by:

- Reductions of velocities in the ductwork.
- Sufficient numbers and sizes of attenuators installed in air systems with due allowance made for the static pressure loss.
- Acoustic screens provided where noise generated by any plant or equipment installed by the Mechanical Services Installer causes external noise levels to exceed those specified.
- Anti-vibration mounts and flexible connections installed on rotating and reciprocating plant to eliminate all vibration from the structure.
- Any other measures necessary to meet the requirements of the Specification are carried out.

The complete installation to a particular space, shall not be considered acceptable until the noise rating levels specified have been achieved with all engineering services functioning in their most noise productive mode. Demonstration shall be required showing that these levels have been achieved together with the other design performance requirements. Failure to achieve required noise rating levels resulting in the installation of new or additional vibration/acoustic treatment necessary to achieve the specified noise rating levels shall be at no additional cost to the contract.

2. NOISE CRITERIA

2.1. Internal Criteria

Noise criteria are normally contained within the project documentation. If this is not stated, the following general guidance is given. Criteria shall be finally agreed with the engineer before final selection of equipment.
The noise criteria shall be met when the building is completed, but unoccupied and when all the building services are operating at their highest likely noise level

Situation	Noise Rating (NR)
Offices:	
- Boardroom, Large Conference Room	25 - 30
- Small Conference Room, Executive Office, Reception Room	30 - 35
- Open Plan Office	35
- Drawing Office, Computer Suite	35 - 45
Industrial:	
- Warehouse, Garage	45 - 50
- Light Engineering Workshop	45 - 55
- Heavy Engineering Workshop	50 - 65

2.2. External Criteria

Noise generated by plant and equipment installed on the project, including that radiating from internal plant and louvres, shall not exceed the criteria agreed with local planning authorities or environmental health officers. If no specific guidance is given, then the advice contained within UNI ISO1996 should be followed.

2.3. Ductwork Velocity Criteria

Noise generated by ductwork can usually be ameliorated by reducing the ductwork velocity. The following table should be used for sizing ductwork to reduce noise levels. If the design criteria lie between the values specified, then the values should be interpolated to find the correct ductwork velocity.
For Low Velocity Systems (m/s):

Ductwork Description	NR 25	NR 30	NR 35	NR 40	NR 45
Riser	4.0	5.0	7.0	9.0	11.0
Main Branch	3.0	4.0	5.0	6.0	7.0
Run-out on floors	2.0	3.0	3.5	4.0	4.5
Terminal duct	1.5	2.0	2.5	3.0	3.5
Grill	1.5	2.0	2.5	3.0	3.5
Diffuser	1.0	1.5	2.0	2.5	3.0
Extract stub ducts (above ceiling)	1.5	2.0	3.0	4.0	5.0

For High Velocity Systems (m/s):

Ductwork Description	NR 25	NR 30	NR 35	NR 40	NR 45
Riser	-	-	11.0	11.0	12.0
Main Branch	-	-	5.0	86.0	9.0
Run-out on floors to terminal unit	-	-	3.5	6.0	7.0
Downstream from terminal unit	As low velocity systems above				

Where the velocity in the ductwork is required to be greater than the appropriate figure in the tables, the contractor must agree the velocity with the engineer and acoustic consultant.

3. AIRBORNE NOISE CONTROL

3.1. Duct-mounted Absorptive Attenuators

3.1.1. Performance

Each attenuator supplied by the contractor shall provide an insertion loss of not less than that indicated in the project documents.
Attenuator ratings shall be determined in accordance with ISO 7235. Acoustic ratings shall include static and dynamic insertion loss and noise regenerated power levels, at up to 10 m/s face velocity and at design flow rate.
Static pressure loss of silencers shall not exceed those specified at the required airflow, the maximum allowable pressure being 50 Pa unless otherwise agreed with the engineer. Airflow measurements shall be made in accordance with applicable portions of ABMI, AMCA, EN and ADC airflow test codes.
The manufacturer shall supply with submittals certified test data on dynamic insertion loss, self-noise power levels and aerodynamic performance. The certifying laboratory shall be open to inspection upon request from the engineer.

3.1.2. Construction

Casings shall be manufactured from 0.8 mm thick galvanised sheet steel to UNI EN 10346 continuously lock-formed and mastic sealed.
Internal surfaces shall be constructed from not less than 0.8 mm perforated galvanised sheet metal complying with UNI EN 10346 incorporating aerodynamic leading and trailing edges (not square ends). Attenuators not longer than 900 mm shall have an aerodynamic leading edge. Locating and stiffening members shall be not less than 0.8 mm thick galvanised sheet metal. The composite splitter shall be secured to the casing by electrolytically compatible rivets located in such a manner as to prevent their ingress into the air stream in the event of a mechanical fastener failure. The splitters shall be secure regardless of vertical or horizontal location.
Splitter infill materials shall be of inorganic mineral or glass fibre of a density sufficient to obtain the specified acoustic performance and packed under not less than 5% compression to eliminate voids due to vibration and settling. Materials shall be inert, vermin and moisture proof. All internal surfaces shall be sealed against fibre release.
Combustion rating for the silencer acoustic fill shall not be less than the following when tested in accordance with the local Italian Fire Prevention Code (Testo coordinato dell'allegato I del DM Codice di prevenzione incendi):

- Flame Spread Classification GM2
- Smoke Development Rating GM2

Attenuators shall have a regular splitter / airway dimension across the full width of the unit. It is the contractor's responsibility to ensure that the splitter elements are correctly orientated for the adjacent duct geometry, particularly adjacent to fans, bends, bifurcations, etc.
Attenuators shall be delivered to site with ends wrapped in polythene and stored in this condition to prevent contamination before installation.
The acoustic media shall not comprise materials which are generally composed of mineral fibres, either man-made or naturally occurring, which have a diameter of 3 microns or less and a length of 200 microns or less, which contain any fibres not sealed or otherwise stabilised to ensure fibre migration is prevented.
Where required, the attenuator shall be internally lined with Melinex to prevent the ingress of grease, water vapour and other deleterious chemicals into the acoustic media. Melinex lining may be required for hospital systems and clean rooms to prevent fibre egress. Since the lining may decrease the acoustic performance, the contractor shall ensure that this is taken into account when selecting the equipment.

3.1.3. Location

Attenuators shall generally be fitted immediately adjacent to the sound emitting plant. Where this is not possible the location shall be agreed with the engineer, and the ductwork between the noise generating plant and attenuator shall be acoustically lagged in accordance with the acoustic insulation of ductwork section of this specification in order to prevent excessive noise breakout.
Attenuators should be located in order to uniformly distribute the flow of air across the attenuator. Ideally a minimum distance of five duct diameters should be allowed between any attenuator and any bends, tees, sets or grilles.
Where this is not possible due to bends or duct take-offs, a flow straightener should be incorporated into the attenuator to ensure the insertion loss is achieved evenly across the duct. The flow straightener pressure drop and regenerated noise should be included in the aerodynamic and acoustic ratings of the attenuator.

3.2. Roof mounted Plant Attenuators

If enclosure of roof plant is impractical due to airflow requirements then intake and discharge attenuators are required. The outer skin of the attenuators shall be manufactured from not less than 1.25 mm zinc-coated mild steel and the inner surface not less than 0.8 mm galvanised perforated mild steel
Attenuators shall be provided by the manufacturer of the roof mounted plant in order to ensure the normal operation and maintenance of the machine to the manufacturer's requirements.
Intake attenuators shall be supplied with an integral bird screen (or insect screen, if applicable to the application) of galvanised mild steel or aluminium mesh, fixed to its internal face. The mesh pitch shall be a maximum of 25 mm.
Roof Mounted attenuators shall be protected against the weather as per the external ductwork section of this specification.
If louvres are required as part of the intake or discharge of the plant, then these should be constructed as per the acoustic louvres described in the next paragraph.

3.3. Acoustic Weather Louvres

3.3.1. Performance

All acoustic weather louvres shall provide an insertion loss, under normal operating conditions, of not less than that indicated in the relevant acoustic hardware schedules.
The static pressure loss shall not normally exceed 25 Pa at a face velocity of 1.5 m/s at design operating conditions.
The louvres shall be designed to prevent the ingress of rain under normally encountered conditions.

3.3.2. Construction

The louvre frame shall be constructed from a suitable gauge of galvanised mild steel, or aluminium, supporting louvre blades of like material.
The acoustic material in the blades shall have a minimum density of 48 kg/m³ packed to a minimum of 10% compression and be inert, rot and vermin proof, non-hydroscopic and incombustible mineral fibre, faced with mineral fibre tissue and retained on the lower blade face by perforated, galvanised mild steel or aluminium.
Where required, the attenuator shall be internally lined with Melinex to prevent the ingress of grease, water vapour and other deleterious chemicals into the acoustic media. Melinex lining may be required for hospital systems and clean rooms to prevent fibre egress. Since the lining may decrease the acoustic performance, the Contractor shall ensure that this is taken into account when selecting the equipment.

Where the louvres are manufactured in sections, each unit shall be shop assembled as a whole unit. If the louvre is manufactured in sections, then the manufacturer's own guarantee and performance ratings, must apply to the unit as a whole.
Acoustic weather louvres shall be supplied with an integral bird screen (or insect screen, if applicable to the application) of galvanised mild steel or aluminium mesh, fixed to its internal face. The mesh pitch shall be a maximum of 25 mm.
The louvres shall be supplied complete with all necessary fixings, flanges, etc., for fitting into the louvre opening.
All gaps between the outside of the louvre frame and the wall or duct shall be made good and sealed with a heavy grout and / or non-hardening dense mastic.
The acoustic media shall not comprise materials which are generally composed of mineral fibres, either man-made or naturally occurring, which have a diameter of 3 microns or less and a length of 200 microns or less or which contain any fibres not sealed or otherwise established to ensure that fibre migration is prevented.
The contractor shall ensure that no materials are used in the construction of a deleterious nature.
The colour and finish of the louvres shall be in accordance with the architect's requirements.

3.4. External Acoustic Insulation of Ductwork

3.4.1. General

Where noise criteria cannot be met by the ductwork or thermal insulation covering, then external acoustic insulation shall be applied.
This must have sufficient performance to meet the criteria, but would normally be of one of the following constructions:

3.4.2. Standard

Resilient Layer: 40 mm (minimum) thickness of mineral wool or fibreglass having a density of approximately 70 kg/m³, or 40 mm (minimum) thick Lamella mat at a density of 45 kg/m³.
Outer Mass Skin: either a high-density sound-deadening mat (7 kg/m²) or a 2 mm thick lead sheet.

3.4.3. Heavy Duty

Resilient Layer: 75 mm (minimum) thickness of mineral wool or fibreglass having a density of approximately 70 kg/m³, or 75 mm (minimum) thick Lamella mat at a density of 45 kg/m³.
Outer Mass Skin: 2 mm sheet steel, 19 mm plasterboard plank, or other sheet material of surface density no less than 15 kg/m².
The sheet material shall be fixed to an independently supported timber or steel frame, which does not come into direct contact with the ductwork. All joints shall be taped and sealed with caulking or suitable dense mastic.
With either type of lagging, the outer mass skin shall not at any point come into direct contact with the ductwork, especially at flanged joints and hangers. Similarly, it shall not come into contact with the building structure. In addition, it must be ensured that the whole acoustic lagging system is tightly fitted, with the resilient layer under slight compression at all points to eliminate voids and prevent flexing of the outer mass skin. It shall be ensured that all joints in the system are staggered and lapped by not less than 50 mm. Direct butt joints shall not be permitted.
Proprietary acoustic duct insulation products may be used providing these have adequate performance and have been agreed by the engineer and acoustic consultant.
All products must have the appropriate fire-rating class in adherence with the classification given in the table n° 25 of the FLS report.

3.5. Acoustic Flexible Ductwork

The acoustic flexible ductwork shall conform to all requirements in the standard specification as well as the following additional criteria.
Flexible ducting shall be of the acoustic type with the equivalent of 25 mm thickness, 64-96 kg/m³ Rockwool or 32 kg/m³ fibre-glass.
Flexible connection shall have an unsupported length of not more than 100 mm and not less than 25 mm. The connection shall not be tensioned to allow transmission of vibration.
Any misalignment between the two sides of the flexible shall be corrected immediately.
No ductwork or plant shall be supported from the flexible connection.
The flexible connection shall be clamped or bonded throughout its entire length to its mating flange or duct connector.
Flexible connections shall be suitable for the design working pressure of the system.

3.6. Internal Lining of Ductwork

Internal lining of ductwork is generally not recommended. Use should normally be made of purpose-made splitter type attenuators to reduce noise levels.
Where internal lining has been agreed it should be fitted before the ductwork is installed on site and shall have the same fire performance as that specified for duct and thermal insulation (see appropriate section of this specification). Where access panels, duct take-offs and other penetrations are made through the acoustic media, repairs shall be made once the installation is complete in order to maintain the acoustic properties of the duct.
The ability to be able to subsequently internally clean the ductwork must be demonstrated and no material shall be used that would release fibres into the air stream shall be used.
Any lining must be securely bonded to the ductwork. The bonding must have a useful life equal to or greater than the ductwork and the acoustic lining to ensure that the acoustic lining remains bonded to the ductwork. The lined ductwork should be tested in accordance with BESA DW 144 and local Italian codes. If required an additional test should be performed where the air should be passed down the duct at twice the maximum design velocity to ensure that the lining remains bonded to the ductwork.
Adjacent sections of lining should abut with minimal gap and have an integral or separate surface finish lap to such joints.
Access panels shall be provided at frequent intervals to enable inspection of the internal lining.
Where linings are fitted to ductwork, plenum boxes and terminal units the same principles as outlined above shall apply.
Lining fire rating class in adherence with the classification given in the table n° 25 of the FLS report.

3.7. Acoustic Enclosures

Plant mounted externally to the building shall be enclosed where necessary to ensure that the effect of the noise generated by such plant on room and external noise levels does not raise the levels above the specified noise criteria.
Acoustic enclosures shall be constructed from double skinned acoustic panels suitable for external applications. Each enclosure shall be designed to suit the application. As a minimum, the outer skin of the panels shall be manufactured from not less than 1.25 mm zinc-coated mild steel and the inner surface not less than 0.8 mm galvanised perforated mild steel.
Infill media shall be 48 kg/m³ mineral wool compression packed to prevent settlement. Panels shall have a mean internal sound absorption co-efficient to UNI EN ISO 354 of not less than 0.85 and a mean SRI to ISO 10140, as appropriate, of not less than 40 dB.
The panels shall be structurally self-supporting without additional stiffening. All steelwork shall be provided by the specialist manufacturer and be galvanised after manufacture.
Doors, access panels, windows, ventilation duct and electrical cable penetrations shall be minimised where possible and treated so as to maintain the specified acoustic performance of the assembled enclosure.
All access doors and demountable sections shall be designed to allow easy disassembly and reassembly by unskilled personnel without affecting the acoustic performance. Each door and demountable section shall have a double rubber gasket seal to minimise any openings in the construction of the acoustic enclosure.
Due to the high loads imposed on the building by external housings, no enclosure shall be erected without prior verification of the loads and fixings by the structural engineer.

4. STRUCTURE BORNE NOISE AND VIBRATION CONTROL

4.1. General

The Contractor shall take all necessary steps to ensure that no sound or vibration, above the accepted criteria, is transmitted to the occupied spaces via machinery. Measures may include:

- Vibration isolators.
- Acoustically treated plant bases.
- Ductwork flexible connections.
- Pipework flexible connections.

4.2. Levels of Vibration of Building Structure

The vibration of the surface of the building due to the engineering services shall not be perceptible to occupants sitting, standing or lying down in all occupied areas except plant rooms and service areas.
The vibration dose value (VDV) shall be used to ensure that the vibration due to the building structure shall cause a low probability of adverse comment. The methodology is detailed in UNI ISO 2631 and in and d.lgs. 81/2008. For offices, the

VDV values below shall be used. To ensure that the vibration due to the building structure shall cause a low probability of adverse comment refer to UNI ISO 2631 "Evaluation of human exposure to whole-body vibration" and d.lgs. 81/2008. Vibration of the building surfaces at audible frequencies shall not cause sound pressure levels which exceed the criteria specified for that space.

4.3. Vibration Isolators

4.3.1. General

Design guidance for the selection of vibration isolators shall be taken from ASHRAE Applications Handbook, Chapter 47 Table 48 and notes, shown below. This table should be used as a guide only with any calculations and drawings of vibration isolation to be approved by the relevant engineer(s).

Equipment Type	Shaft Power (kW) and Other	RPM	Floor Span					
			6 to 9 m			9 to 12 m		
			Base Type	Isolator Type	Min Defl. mm	Base Type	Isolator Type	Min Defl. mm
Air Compressors and Vacuum Pumps								
Tank-Mounted Horizontal	<7.5	All	A	3	19	A	3	19
	>11	All	C	3	19	C	3	19
Tank -Mounted Vertical	All	All	C	3	19	C	3	19
Base-Mounted	All	All	C	3	19	C	3	19
Large Reciprocating	All	All	C	3	19	C	3	19
Pumps								
Close -Coupled	<5.6	All	B	2	6.4	C	3	19
	>7.5	All	C	3	19	C	3	19
Large Inline	3.7 to 19	All	A	3	19	A	3	38
	>22	All	A	3	38	A	3	38
End Suction and Split Case	<30	All	C	3	19	C	3	19
	37 to 93	All	C	3	19	C	3	19
	>110	All	C	3	19	C	3	38
Axial Fans, Fan Heads, Cabinet Fans, Fan Sections								
Up to 600 mm Diameter	All	All	A	2	6.4	A	3	19
600 mm Diameter and up	<500 Pa	Up to 300	B	3	64	C	3	89
		300 to 500	B	3	19	B	3	38
		501 and Up	B	3	19	B	3	38
600 mm Diameter and up	>501 Pa	Up to 300	C	3	64	C	3	89
		300 to 500	C	3	38	C	3	38
		501 and Up	C	3	19	C	3	38
Centrifugal Fans								
Up to 600 mm diameter	All	All	B	2	6.4	B	3	19
600 mm Diameter and	<30	Up to 300	B	3	64	B	3	89

Equipment Type	Shaft Power (kW) and Other	RPM	Floor Span					
			6 to 9 m			9 to 12 m		
			Base Type	Isolator Type	Min Defl. mm	Base Type	Isolator Type	Min Defl. mm
Up		300 to 500	B	3	38	B	3	38
		501 and Up	B	3	19	B	3	19
	>37	Up to 300	C	3	64	C	3	89
		300 to 500	C	3	38	C	3	38
		501 and Up	C	3	25.4	C	3	38
Heat Pumps								
	All	All	A	3	19	A	3	19
Condensing Units								
	All	All	A	1	6.4	A	4	19
Packaged AHUs								
All	7.5	All	A	3	19	A	3	19
	<11	Up to 300	A	3	19	A	3	89
		301 to 500	A	3	19	A	3	64
		501 and Up	A	3	19	A	3	38
	>11	Up to 300	B	3	19	C	3	89
		301 to 500	B	3	19	C	3	38
		501 and Up	B	3	19	C	3	38
Packaged Rooftop Equipment								
	All	All	A/D	1	6.4	D	3	19
Ducted Rotating Equipment								
Small Fans	<300 l/s	All	A	3	12.7	A	3	12.7
	>301 l/s	All	A	3	19	A	3	19
Engine-Driven Generators								
	All	All	A	3	19	C	3	38
Pumps								
Close -Coupled	<5.6	All	C	3	19	C	3	19
	>7.5	All	C	3	38	C	3	38
Large Inline	3.7 to 19	All	A	3	38	A	3	38
	>22	All	A	3	38	A	3	64
End Suction and Split Case	<30	All	C	3	38	C	3	38
	37 to 93	All	C	3	38	C	3	64
	>110	All	C	3	64	C	3	89
Axial Fans, Fan Heads, Cabinet Fans, Fan Sections								
Up to 600 mm Diameter	All	All	A	3	19	C	3	19

Equipment Type	Shaft Power (kW) and Other	RPM	Floor Span					
			6 to 9 m			9 to 12 m		
			Base Type	Isolator Type	Min Defl. mm	Base Type	Isolator Type	Min Defl. mm
600 mm Diameter and up	<500 Pa	Up to 300	C	3	89	C	3	89
		300 to 500	C	3	64	C	3	64
		501 and Up	B	3	38	B	3	38
600 mm Diameter and up	>500 Pa	Up to 300	C	3	89	C	3	89
		300 to 500	C	3	64	C	3	64
		501 and Up	C	3	38	C	3	64
Centrifugal Fans								
Up to 600 mm diameter	All	All	B	3	19	C	3	38
600 mm Diameter and Up	<30	Up to 300	B	3	89	B	3	89
		300 to 500	B	3	64	B	3	64
		501 and Up	B	3	19	B	3	38
	>30	Up to 300	C	3	89	C	3	89
		300 to 500	C	3	64	C	3	64
		501 and Up	C	3	38	C	3	64
Heat Pumps								
	All	All	A	3	19	A/D	3	38
Condensing Units								
	All	All	A	4	38	A/D	4	38
Packaged AHUs								
	7.5	All	A	3	19	A	3	19
	<11	Up to 300	A	3	89	C	3	89
		301 to 500	A	3	64	A	3	64
		501 and Up	A	3	38	A	3	38
	>11	Up to 300	C	3	89	C	3	89
		301 to 500	C	3	64	C	3	64
		501 and Up	C	3	38	C	3	64
Ducted Rotating Equipment								
Small Fans	<300 L/s	All	A	3	12.7	A	3	12.7
	>301	All	A	3	19	A	3	19

Equipment Type	Shaft Power (kW) and Other	RPM	Floor Span					
			6 to 9 m			9 to 12 m		
			Base Type	Isolator Type	Min Defl. mm	Base Type	Isolator Type	Min Defl. mm
	L/s							
Engine-Driven Generators								
	All	All	C	3	64	C	3	89

Base Types:
- No base, isolators attached directly to equipment
- Structural steel rails or base
- Concrete inertia base
- Curb-mounted base

Isolator Types:
- Pad, rubber or glass fibre (see below)
- Rubber floor isolator or hanger (see below)
- Spring floor isolator or hanger (see below)
- Restrained spring isolator (see below)
- Thrust restraints (see below)

Notes for Table:
- Isolator deflections shown are based on reasonably expected floor stiffness according to floor span and class of equipment. Certain spaces may dictate higher levels of isolation.
- For large equipment, capable of generating substantial vibratory forces and structure borne noise, increase isolator deflection, if necessary, so isolator stiffness is less than one-tenth the stiffness of the supporting structure.
- Certain designs cannot be installed directly on individual isolators (type A), and the equipment manufacturer or a vibration specialist should be consulted on the need for supplemental support (base type).
- To avoid isolator resonance problems, select isolator deflection so that resonance frequency is 40% or less of the lowest normal operating speed of equipment
- To limit undesirable movement, thrust restraints (type 5) are required for all ceiling-suspended and floor-mounted units operating at 500 Pa or more total static pressure.

5. ISOLATION GUIDANCE FOR SPECIFIC EQUIPMENT

5.1. Variable Speed Machinery

Systems shall achieve the degrees of isolation specified at all the normal operating speeds of the equipment. The resonant frequency of the isolation system shall be at least half the value of operating frequency.
The resonant frequency of isolation systems for machinery and electric motors with stepped speed starting arrangements (star delta, tapped resistor and transformer etc,) shall not correspond to any of the speeds at the step changes and shall allow for long 'run-up' and 'run-down' times.

5.2. Pumps

Concrete inertia bases (type C) are preferred for all flexible-coupled pumps and are desirable for most close-coupled pumps, although steel bases (type B) can be used.
Close-coupled pumps should not be installed directly on individual isolators (type A) because the impeller usually overhangs the motor support base, causing the rear mounting to be in tension. The primary requirements for type C bases are strength and shape to accommodate base elbow supports.
Concrete bases (type C) should be designed for a thickness of one-tenth the longest dimension with minimum thickness as follows:
- for up to 20 kW, 150 mm;

- for 30 to 55 kW, 200 mm;
- for 75 kW and up, 300 mm.

Pumps over 55 kW and multistage pumps may exhibit excessive motion at start-up ("heaving"); supplemental restraining devices can be installed if necessary.

5.3. Packaged Rooftop Air-Conditioning Equipment

This equipment is usually on lightweight structures that are susceptible to sound and vibration transmission. The noise problem is further compounded by curb-mounted equipment, which requires large roof openings for supply and return air.
For mechanical units, capable of generating high noise levels, mount the unit on a platform above the roof deck to provide an air gap (buffer zone) and locate the unit away from the associated roof penetration to allow acoustical treatment of ducts before they enter the building.
Some rooftop equipment has compressors, fans, and other equipment isolated internally. This isolation is not always reliable because of internal short-circuiting, inadequate static deflection, or panel resonances. It is recommended that rooftop equipment be isolated externally, as if internal isolation was not used.

5.4. Cooling Towers

These are normally isolated with restrained spring isolators (type 4) directly under the tower. High-deflection isolators proposed for use directly under the motor fan assembly must be used with extreme caution to ensure stability and safety under all weather conditions.

5.5. Fans and Air-Handling Equipment

Fans with diameters of 560 mm and less and all fans operating at speeds up to 300 rpm do not generate large vibratory forces and may not require isolation.
For fans operating under 300 rpm, select isolator deflection so the isolator natural frequency is 40% or less than the fan speed
Flexible duct connectors should be installed at the intake and discharge of all fans and air-handling equipment to reduce vibration transmission to air duct structures.
Inertia bases (type C) are recommended for all large fans and air-handling equipment because extra mass allows the use of stiffer springs, which limit heaving movements.
Thrust restraints (type 5) that incorporate the same deflection as isolators should be used for all fan heads, all suspended fans, and all base-mounted and suspended air-handling equipment operating at 500 Pa or more total static pressure. Restraint movement adjustment must be made under normal operational static pressures.

5.6. Generator and Engine Noise

Refer to the generator specification for further advice.

5.7. General Vibration Isolation Construction

It is the contractor's responsibility to ensure that all mountings offered are suitable for the loads, operating and environmental conditions which will prevail. Particular attention shall be paid to mountings which will be exposed to atmospheric conditions to prevent corrosion.
All mountings shall provide the static deflection required, under the equipment weight, shown on the contractor's schedules.
The resonant frequency of the isolation system should never be between 0.5 and 1.5 the disturbing frequency of the system.
Vibration isolation systems whose mountings can be overloaded by excessive deflections, not caused by the running machine or normal service, shall be provided with 'bottoming' or similar restraints which may be part of the mountings, machinery or bases. The restraint shall also prevent the equipment position changing if its load changes, for example, during draining down of the equipment or other maintenance.
The device shall consist of a stud passing through an oversize hole with a nut and locknut providing restraint. A fibre or neoprene washer shall be fitted between nut and restraining member, leaving a clearance of at least 1 mm.
Mounting selection shall allow for any eccentric load distribution or torque reaction, so that the design deflection is achieved on all mountings under the equipment, under operating conditions.

All mounting shall be colour-coded or otherwise marked, to indicate their local capacity, to facilitate identification during installation.
The width of the air gap between undersides of solid machine bases supported on vibration isolation mountings and the floor shall be selected to avoid resonance of the air gap at the major vibrational or acoustic frequencies generated by the supported plant.
The distance between the panels of the air handling units and floors, walls, or soffits shall be chosen to avoid resonance of the panel and air gap at the fan or motor rotational and fan blade passing frequencies.

5.8. Rubber / Neoprene Mounts

Isolators are designed for up to 13 mm deflection but are used where 8 mm or less deflection is required. Solid rubber and composite fabric and rubber pads can also be used. They provide high load capacities with small deflection and are used as noise barriers under columns and for pipe supports.
Each mounting shall comprise of a steel top plate and base plate completely embedded in coloured, oil-resistant neoprene or rubber with the colour identifying the load capacity.
Each mounting shall be used with the mounting material being used in compression. Tension or sheer type mountings shall be avoided.
Each mounting shall be capable of being fitted with a levelling device, shall have bolt holes in the base plate and a threaded metal insert in the top plate so that they can be bolted to the floor and equipment, where required. The levelling device should not short-circuit the vibration isolation.
Manufacturer's stated maximum loadings shall not be exceeded.
This type of device shall not be used where ambient or equipment frame temperature exceeds 70°C unless manufacturer's certificates indicating suitability for operating at higher temperatures can be provided.

5.9. Open Helical Steel Spring Compression Mountings

Steel springs are the most popular and versatile isolators for HVAC applications because they are available for almost any deflection and have a virtually unlimited life. All spring isolators should have a rubber acoustical barrier to reduce transmission of high-frequency vibration and noise that can migrate down the steel spring coil. They should be corrosion-protected if installed outdoors or in a corrosive environment.
Helical Steel Spring Compression Mountings shall comprise single or multiple spring elements, shall be freestanding and laterally stable and shall be provided with a synthetic rubber or elastomeric friction pad fitted to the base plate designed to attenuate any high frequency energy transmitted by the spring. All springs shall have coil diameters of not less than 0.80 of the compressed height at the rated load to ensure stability.
All mountings shall have levelling bolts that must be rigidly bolted to the equipment. There shall be provision for bolting through the top and bottom plate. The levelling device should not short-circuit the vibration isolation.
Mountings shall have 50% of rated static deflection additional travel before becoming coil bound to cater for plant and equipment weight and superimposed load variations and inaccuracies.
Springs should be designed with a horizontal stiffness of at least 100% of the vertical stiffness to ensure stability verified by a minimum ratio of 0.8 for the diameter of the spring divided by the deflected spring height.

5.10. Vertically Restrained Helical Steel Spring Compression Mountings

Steel springs are the most popular and versatile isolators for HVAC applications because they are available for almost any deflection and have a virtually unlimited life. All spring isolators should have a rubber acoustical barrier to reduce transmission of high-frequency vibration and noise that can migrate down the steel spring coil. They should be corrosion-protected if installed outdoors or in a corrosive environment.
Vertically restrained helical steel spring compression mountings shall be used in cases where equipment has an operating weight different from the installed height and where equipment is exposed to wind loading.
Mountings shall be as described under the clause for open helical steel spring compression mountings, but include a mechanism that provides an adjustable vertical limit stop to prevent spring extension when load is decreased. The mechanism should not short-circuit the vibration isolation.
Mountings used in the external environment shall exhibit an additional deflection capacity and restraint mechanism capable to accepting the rated load plus 150 kg/m² of equipment face area (ratio seen at each mount). The largest face area shall be employed in calculations.
Mountings used in the external environment must be adequately protected against environmental and atmospheric degradation.

5.11. Horizontally Restrained Helical Steel Spring Mountings

Horizontally restrained helical steel spring mountings shall be used in cases where equipment regularly cycles on and off and in cases where horizontal periodic loads may occur.
Horizontal restraints shall be incorporated into the design of the mounting and shall be such that short-circuiting shall not be possible. Synthetic rubber or elastomer inserts having adequate compressive strength shall be used to provide a horizontal buffer to limit excessive movement. Snubbers shall be out of contact during normal operation. Mountings shall be as described under the clause for Open Helical Steel Spring Compression Mountings.

5.12. Mat and Pad Mountings

Mat and pad mountings shall comprise configured synthetic rubber (or elastomer such as neoprene) in compression between two rigid and flat surfaces.
Pads and mats shall normally be bonded to both supporting surfaces.
Mat and pad mounts shall be cut to the appropriate size to provide the specified minimum static deflection. No pad shall be smaller than 50 x 50 x 5 mm.
The mat and pad mountings may be stacked to increase unit deflection, but overall stacked and loaded height must not exceed 40 mm. When stacking, 18 swg steel sheet shall be bonded between each pad without filling voids. Where the above dimensions become impractical, the installed aspect ratio of width to height shall be 0.80 or less.
The contractor shall ensure that mat and pad mountings are not employed where ambient or equipment frame temperatures exceed 70°C unless manufacturers' certificates of high temperature worthiness are produced to the Engineer for approval.
Mat and pad mountings should be corrosion-protected if installed outdoors or in a corrosive environment.

5.13. Vibration Isolating Pipe Support Hangers

Vibration isolating pipe support hangers shall be used on all pipework within 5 m of all vibrating plant and equipment.
If services run through noise sensitive areas (criteria NR30 or less) then pipework shall be isolated as follows:
Pipe sizes 35 mm or less – Resilient insert within pipe clamp within 20 m of isolated plant
Pipe sizes 100 mm or less – Spring hanger with low deflection resilient pad within 30 m of isolated plant
Pipe sizes greater than 100 mm – Spring hanger with low deflection resilient pad within 50 m of isolated plant
The support vibration isolators shall provide the same static deflection as the equipment supports, for the length of service relating to the first type of the pipe support isolation specification.

5.14. Hanger Neoprene / Rubber Compression Mountings

Hanger neoprene / rubber compression mountings shall comprise neoprene / rubber compression mountings generally in accordance with the foregoing clause for this type of mounting incorporated within a steel hanger box.
The hanger box shall be constructed from at least 16 swg steel and have construction with mechanical strength commensurate with design loads. Boxes shall have an upper fixing hole and an enlarged bottom hole through which the drop rod contacts the supported plant or equipment. The lower box hole diameter shall be adequately sized to provide free drop rod movement up to 35° free vertical in any direction in order to compensate for thermal and other movement of supported equipment.
Swivel or traveller arrangements may be necessary for connections to piping systems subject to large thermal movements.

5.15. Hanger Open Helical Steel Spring Compression Joints

Hanger open helical steel spring compression mountings shall comprise open helical steel springs from mountings generally in accordance with the foregoing clause for this type of mounting incorporated within a steel hanger box, with synthetic rubber elastomer being at least one end of the spring.
The hanger box shall be constructed from at least 16 swg steel and have construction with mechanical strength commensurate with design loads. Boxes shall have an upper fixing hole and an enlarged bottom hole through which the drop rods connect the supported plant to equipment. The lower box hole diameter shall be adequately sized to provide free drop rod movement up to 35° from vertical in any direction in order to compensate for thermal and other movement of supported equipment.

5.16. Pipe Wall and Riser Seal

Where piped services associated with rotating machinery pass through plantroom floors and walls, they shall be enclosed concentrically within purpose-made sleeves, cut square from steel pipe three sizes larger and three penetration thicknesses in length.
Sleeves shall be grouted into the wall / floor and in no case be used as pipe supports, a free annular space always being provided. The space between sleeve and pipe shall then be sealed by packing with mineral wool or glass fibre sleeve for the depth of the wall / floor minus 12 mm.
A 12 mm thick non-hardening cold mastic seal shall then be applied to both ends of the packing to bring the joint level with the sleeve end.

6. PLANT BASES

6.1. Steel Equipment Bases

Structural rails (type B) are used to support equipment that does not require a unitary base or where the isolators are outside the equipment and the rails act as a cradle.
Steel frame equipment bases shall be made sufficiently rigid to enable permanent equipment alignment and supports and adequately stiff to prevent resonances at operating frequencies of supported equipment.
Perimeter steel beams shall have a depth of not less than 1/10 the longest dimension of the base and not less than 150 mm. Cross-framing should be used to provide adequate strength and stiffness.
Maximum depth is limited to 300 mm except where structural considerations dictate otherwise.

6.2. Concrete Equipment Bases

Structural bases (type B) are used where equipment cannot be supported at individual locations and/or where some means is necessary to maintain alignment of component parts in equipment.
Concrete equipment bases shall comprise a reinforced steel concrete base of depth not less than 150 mm cast in-situ over 16 swg steel sheet of identical plan dimensions. The concrete base shall be designed to have the equipment weight bolted directly to it.
A layer of mat mounting material of minimum thickness 20 mm, which is placed over a concrete up stand base of depth not less than 70 mm, cast into the structural floor.

6.3. Concrete Inertia Bases

All pumps except inline pumps less than 100 mm inlet diameter shall be installed on inertia bases.
Concrete inertia bases shall be formed from steel beam shuttering with perimeter beams having a depth of not less than 1/10 the largest dimension of the base of 150 mm (whichever is the greater) and no greater than 300 mm.
The bottom of the frame shall be blanked off and concrete (min. 2300 kg/m^3) poured in over steel reinforcing. This reinforcing should consist of 13 mm diameter bars welded on 150 mm centres running cross-batch in a layer 35 mm above the bottom of the base and no greater than 300 mm unless required, or as specified by the structural Engineer.
The inertia base shall be sufficiently large to provide support for all parts of the equipment base, such as suction and discharge elbows on centrifugal pumps.
Unless otherwise specified in the Schedules, the weight of the base shall be twice that of the supported equipment and the included angle between the mounting positions and overall centre of gravity should be no less than 60°.
To form the inertia base helical spring or neoprene / rubber mountings shall be fixed to the underside (or within pockets) of the base and to the floor.
Mountings shall suit the load and required deflection in accordance with the foregoing clauses.

7. DUCTWORK FLEXIBLE CONNECTIONS

Flexible connections shall be provided at all fans to isolate the fan, acoustically, from the ductwork system. The only exceptions to this are low speed, small inline fans providing they do not cause design noise criteria to be exceeded.
They shall normally be manufactured with a fire rated class in adherence with the classification given in the table n° 25 of the FLS report having a nominal superficial weight of 1 to 7 kg/m^2, depending upon application.
In noise sensitive areas and in plantrooms with ductwork sound insulation, sound barrier mat shall be used having a minimum density of 5 kg/m^2.
Flexible connection shall have an unsupported length of not more than 100 mm and not less than 25 mm. The connection shall not be tensioned to allow transmission of vibration.
Any misalignment between the two sides of the flexible shall be corrected immediately.
No ductwork or plant shall be supported from the flexible connection.

The flexible connection shall be clamped or bonded throughout its entire length to its mating flange or duct connector. Flexible connections shall be suitable for the design working pressure of the system.

8. PIPEWORK FLEXIBLE CONNECTIONS

Flexible connections shall be fitted at all pump suction and discharge connections, compressors, chillers, air-cooled condensers and all other centrifugal, reciprocating or other vibrating equipment.
Flexible connections shall be mounted adjacent to the equipment and as close as possible and care shall be taken during construction to ensure that pipework is correctly aligned to ensure undue stresses are not transferred to the flexible.
No supports shall be installed on the "live" side of equipment.
Wherever working pressure exceeds 1.5 bar (gauge) and in any installation with inertia bases and / or spring hangers, the flexible connections shall be tied. Care shall be taken to ensure that the tie bars are adjusted in accordance with the manufacturer's recommendations.
All flexible connectors shall be fully traceable having the manufacturers' name, date of manufacture, country of origin, type, serial number and diameter moulded into the unit. Only flexibles installed in the same year as original manufacture shall be used.
All flexible connectors on services up to 100°C shall be fully compliant with DIN 4809: Part 1. They shall be suitable for continuous operation at 100°C for 10 years and have a minimum burst pressure of 30 bar (g) after this time.
On potable water, flexible connections must be suitably lined and WRAS, or in-country equivalent, approved.
On temperatures between 100°C and 120°C and on pressures up to 16 bar (g) flexible connections shall be of multiply stainless-steel bellows construction. These shall be corrosion-resistant and have tie rods in all applications.
On all flanged rubber flexible connections, the internal bore of the connecting flanges must equal the diameter of the rubber to avoid pinching. Generally, weld neck flanges shall be used.
Flexible connections on heating services shall be uninsulated, flexible connections on cold and chilled water services shall be insulated and vapour sealed.
An earth bonding multi-strand copper cable, fixed with Tenby rapid clamps and complying with the current edition of the Wiring Regulations shall be provided across each flexible joint